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ASSESSMENT OF POTENTIAL FOR COMMONALITY OF ADP FOR ARMY AND MARINE CORPS C2 IN SELECTED FUNCTIONAL AREAS

Volume II: Expanded Technical Briefing

R. P. Walker, *Project Leader*

December 1989

Prepared for
Deputy Under Secretary of Defense for Acquisition (Tactical Warfare Programs/Land Warfare)
and
Assistant Secretary of Defense (C3I)

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This briefing reports (1) a review of requirements for ADP support of tactical command and control for the Army and Marine Corps, (2) an analysis of existing or emerging system options of one Service that could potentially be used by the other Service at a system or subsystem level, and (3) identification of options and issues with emphasis on interoperability issues. The assessment is limited to three function areas (maneuver control, fire support, and air operations/airspace control). The system-of-system concepts for Army and Marine Corps tactical systems (ATCCS, MTACCS) are discussed. The assessment concludes that there is substantial commonality of requirements and potential for multi-Service programs leading to fielding common system support of maneuver control, fire support, and battlefield air picture. Further, unless otherwise directed, the two Services may implement incompatible standards for data communications and data management.

14. SUBJECT TERMS
Fire Support, System Concepts, Maneuver Control, Air Operations, Airspace Control, Battlefield Air Picture, Requirements, ATCCS, MTCCS, FIREFLEX, FIREMAN, Interoperability, A2C2, AFATDS, MCS, FAAD C2I, TAIS, DASC, IDASC, Assessment, Concept Evaluation, Acquisition, COM, BOM, Bit-Oriented, MTS

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EXECUTIVE SUMMARY

This study addresses the question of whether there is sufficient commonality of requirements between the Army and the Marine Corps so that multi-Service programs could be developed in maneuver control, fire support, and air operations for airspace coordination and control.

BACKGROUND

The Army has already begun fielding an operational system for maneuver control (MCS) to the heavy divisions, whereas the Marine Corps has unsatisfied ROCs for maneuver (FIREMAN) and force-level (TCO) control. Currently, the Marine Corps is relying on the capabilities provided by Fleet Marine Force (FMF)-developed software and off-the-shelf hardware (FMF Initiatives). The key issue for the assessment of maneuver control is whether the requirements that would drive the selection of an objective system for the Marine Corps could be satisfied by MCS or the FMF Initiatives (or both).

The Services have already begun a multi-Service program to develop a single system to meet the fire support C2 requirements of both the Army (AFATDS) and the Marine Corps (FIREFLEX). The key issue for the fire support assessment is whether fielding a system for both Services could be achieved without a major schedule risk to the existing AFATDS program.

For airspace operations, the study focused on the need and opportunities to provide a battlefield air picture, integrating land warfare situation data with selected air track, aircraft position, and airspace coordination information. The issue for the battlefield air picture is whether such a display is required and can be made available without major investment for use in support of functions other than air defense.

CONCLUSIONS

The assessments conducted in this study show that the Army and the Marine Corps have very similar requirements in all three areas: maneuver control, fire support, and use of a battlefield air picture in air operations for airspace coordination and control. In each of these areas there is potential for the Services to cooperatively develop and field common ADP support.

Specifically, the Army and the Marine Corps could field a common objective system for maneuver control and a common system for fire support. A multi-Service program has already begun for fire support, and the Services are now discussing the possibility of a multi-Service program in maneuver control. Further, the Services have a common need and can be expected to develop similar types of support for a battlefield air picture. A multi-Service program for support of the battlefield air picture could be developed (in support of functions other than air defense).

Unless otherwise directed, the Army and the Marine Corps may implement incompatible standards in their tactical data systems for data communications and data management. Specifically, the two Services have not yet agreed on the protocols to be used to support the agreed-to fire support messages in AFATDS. Further, the Services have different programs for standardizing data elements and other aspects of data management for tactical systems.

COURSES OF ACTION FOR ARMY AND MARINE CORPS

Both Services need to review their current specifications for the type and degree of automation needed to ensure that the appropriate level of detail for ADP support requirements is provided to system developers. The level of detail of the user specification of automation requirements varies greatly between the two Services and among the tactical data systems of each Service. Both Services should consider developing a system to prioritize requirements for each block improvement.

Both Services should continue to reassess the voice and data communications required to support tactical command and control as increasing ADP support is provided in the 1990s and beyond. Potentially, the assessments will lead to additional requirements on tactical data systems that will ensure these systems can operate effectively when fielded communications systems degrade or if enhanced communications systems are not fielded as planned.

As the Army and Marine Corps work together in multi-Service programs for maneuver control and fire support, they should consider the development of concepts that will also apply to the ADP support for Joint Task Force C2. Many of the elements of force-level control, maneuver control, and fire support for (Joint) combined arms operations and MAGTF C2 appear to be very similar to those required for Joint Task Force C2.

The Marine Corps needs to complete work on its revised concept for MTACCS and requirements specification for MAGTF C2 and the four functional areas. Specifically, detailed information exchange requirements are needed to define interfaces among tactical data systems within the functional areas (e.g., between FIREMAN and FIREFLEX) and among the functional areas (e.g., between ATACC and FIREFLEX). Further, the ROC for FIREMAN needs to approved, and the 1978 TCO ROC needs to be reviewed in relation to the revised MTACCS concept. Finally, detailed ADP functions need to be defined by the users to show the type and degree of automation that is to be developed for the tactical data systems in MTACCS.

COURSES OF ACTION FOR OSD

OSD could support Service initiatives that would lead to multi-Service programs to develop common systems for fire support, maneuver control, and a battlefield air picture. A multi-Service fire support program could lead to a common objective system for the Army's AFATDS and the Marine Corps' FIREFLEX with initial operational capability (IOC) in FY94. In addition, a multi-Service maneuver control program could lead to a common objective system for the Army's MCS and the Marine Corps' FIREMAN (and possibly TCO) in FY93. Finally, a multi-Service program could be developed to exploit the opportunities to acquire and distribute a battlefield air picture.

In addition, OSD could request that the Army and the Marine Corps provide briefings on the Service efforts to develop and expand multi-Service initiatives, to adopt common standards between the two Services, and to work together towards use of hardware and software common to both Services.

Finally, OSD could request DCA and JTC3A to take two actions that would improve progress toward interoperability. One would be to ensure that the Army and the Marine Corps quickly complete their discussions on the initial Joint information exchange standards to be used in AFATDS Version 1. Unless agreement is reached, the Services could rely on incompatible data communications protocols. A second action would be for DCA and JTC3A to develop a detailed, long-range plan to focus U.S. initiatives for enhancing civil standards for open systems interconnection for tactical use.

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PART II

TECHNICAL BRIEFING

This technical briefing provides a description of the work completed on IDA Task T-F1-654, *Assessment of Subsystem Commonality for Selected Army and Marine Corps Command and Control (C2) Systems*. A copy of the Task Order, initiated and jointly supported by OUSD(A)/TWP/LW and OASD(C3I)-T&TC3, is provided as Appendix F at the end of this annotated briefing report.

The introductory material includes a statement of the objective of the task, description of the background and guidance provided by OSD for scoping, overview of the technical approach, and the schedule.

The briefing report addresses assessments separately in five areas: system concepts, maneuver control, fire support, air operations, and interoperability. To emphasize the organization of the main part of the briefing into these five areas, each of the assessment charts is headed by a title giving the name of the assessment section. These headings are also provided for the charts included in the appendixes, in order to assist the reader in correlating the additional information of the appendixes with the material selected for the main part of the technical briefing.

The summary provides two types of statements. The first is a brief statement of the conclusions of the IDA task in identifying potential areas of commonality and how this might result in cooperative Service efforts to explore the areas identified. The second consists of brief statements of some potential actions that (1) the Army and Marine Corps and (2) OSD, together with DoD Agencies, might take to support Service efforts to exploit the potential for commonality.

The first two appendixes provide detailed information in support of the maneuver control assessment. Appendix A is a compilation of the requirements for ADP support of maneuver control of both the Army and Marine Corps. These were derived from the approved and most recent draft revised ROCs. Appendix B extracts from the combined requirements those common requirements that form the basis of the conclusion as to the high degree of commonality between the Army and Marine Corps for support of maneuver control.

Appendixes C and D provide background information regarding the system-of-systems concepts for the two Services. Technical information that supports, but is not essential to, the discussion of the assessments is provided in Appendix E.

OUTLINE

- OBJECTIVES
- BACKGROUND AND SCOPE
- TECHNICAL APPROACH AND SCHEDULE
- ASSESSMENTS
    1. Systems Concepts
    2. Maneuver Control
    3. Fire Support
    4. Air Operations for Airspace Coordination
    5. Interoperability
- SUMMARY
- APPENDIXES:
    A. Combined Army and Marine Corps Requirements for Maneuver Control
    B. Consolidated Generic Capability for Maneuver Control
    C. Army Tactical Command and Control System (ATCCS)
    D. Marine Tactical Command and Control System (MTACCS)
    E. Additional Technical Information

RPW 11-22-89-15

The objective of this study is to review Army and Marine Corps requirements in maneuver control, fire support, and air operations in order to identify options for incorporating existing and emerging systems of one Service for use by the other Service. In addition, IDA was asked to identify issues for interoperability that arise in the assessment.

Of specific interest to OSD were:

- Service evaluations of fire support systems, including the Army Concept Evaluation of the Advanced Field Artillery Tactical Data System (AFATDS)
- Army and Marine Corps airspace command and control requirements and systems such as the Marine Corps' Tactical Air Operations Module (TAOM, AN/TYQ-23), Advanced Tactical Air Command Center (ATACC), and Improved Direct Air Support Center (IDASC, AN/TSQ-155), and the Army's Tactical Airspace Integration System (TAIS)
- The Army's Maneuver Control System (MCS).

OBJECTIVES OF THE TASK

- REVIEW ARMY AND MARINE CORPS REQUIREMENTS FOR ADP SUPPORT OF:
  - -- Maneuver Control
  - -- Fire Support
  - -- Air Operations
- IDENTIFY OPTIONS FOR EXISTING AND EMERGING SYSTEMS OF ONE SERVICE TO BE USED BY THE OTHER
- CONTINUE WORK ON ARMY/MARINE CORPS JOINT INTEROPERABILITY ISSUES

RPW-12-18-89-3

In 1986, Congress zeroed funding for the development of AFATDS and the Marine Corps' Marine Integrated Fire and Air Support System (MIFASS) and requested an independent study of Service plans to continue development of fire support C2 systems. IDA was tasked in July 1986 to undertake a study. The results were briefed to OSD and the Services in December 1986, and a report was prepared in February 1987.[1]

At the request of the Commandant of the Marine Corps, the Secretary of the Navy cancelled MIFASS in 1987. As a result of continued interest in OSD and Congress about how the Marine Corps would meet its fire support C2 requirements, OUSD(A)/TWP/LW and OASD(C3I)-T&TC3 tasked IDA in 1988 to review Marine Corps fire support C2 requirements and evaluate the degree to which existing and emerging system options would address, or be modified to address, these requirements. An assessment[2] completed in November 1988 determined that any one of the Advanced Field Artillery Tactical Data System (AFATDS), the Lightweight Tactical Fire Direction System (LTACFIRE), or the Fire Support Team Digital Message Device(FIST DMD) could, with modifications, meet most of the driving Marine Corps requirements for support of fire support C2.

The assessment described in this briefing addresses the continued concern within OSD and Congress as to whether investments in ADP support of C2 by one Service can be further exploited by another Service.

The scope of the task was limited by direction of OSD to three functional areas and C2 systems of the Army and Marine Corps. In maneuver control, the assessment addresses not only maneuver control but also force-level control requirements to support the force Commander and to provide the necessary exchange of information between different functional areas. In fire support, the primary focus is on the multi-Service efforts to cooperatively develop AFATDS for both Services. In air operations, the assessment focuses on airspace coordination and control and, within that area, highlights the commonality of requirements for a battlefield air picture.

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1 IDA Memorandum Report M-519, *An Independent Study of Two Fire Support Systems: AFATDS and MIFASS*, February 1989, UNCLASSIFIED.

2 IDA has conducted two related studies for OSD. In 1985, IDA reviewed ATCCS concepts in IDA Memorandum Report M-107, *An Independent Review of the Army Tactical Command and Control System*, August 1985, UNCLASSIFIED. More recently, IDA assessed Army and Air Force tactical data systems in IDA Report R-326, *Assessment of Tactical Data Systems*, April 1989, SECRET.

BACKGROUND AND SCOPE

- CONGRESSIONAL AND OSD INTEREST IN DEVELOPMENT OF MIFASS AND AFATDS (1986 TO PRESENT)
- OSD INTEREST IN HOW MARINE CORPS FIRE SUPPORT REQUIREMENTS COULD BE MET FOLLOWING THE TERMINATION OF MIFASS
- CONTINUED CONGRESSIONAL AND OSD INTEREST IN WHETHER INVESTMENTS BY ONE SERVICE CAN BE EXPLOITED FURTHER BY ANOTHER SERVICE
- SCOPE
  - -- In maneuver control, consider also force-level requirements
  - -- In fire support, assess potential of a multi-Service AFATDS
  - -- In air operations, focus on airspace coordination and control

RPW 11-26-89-16

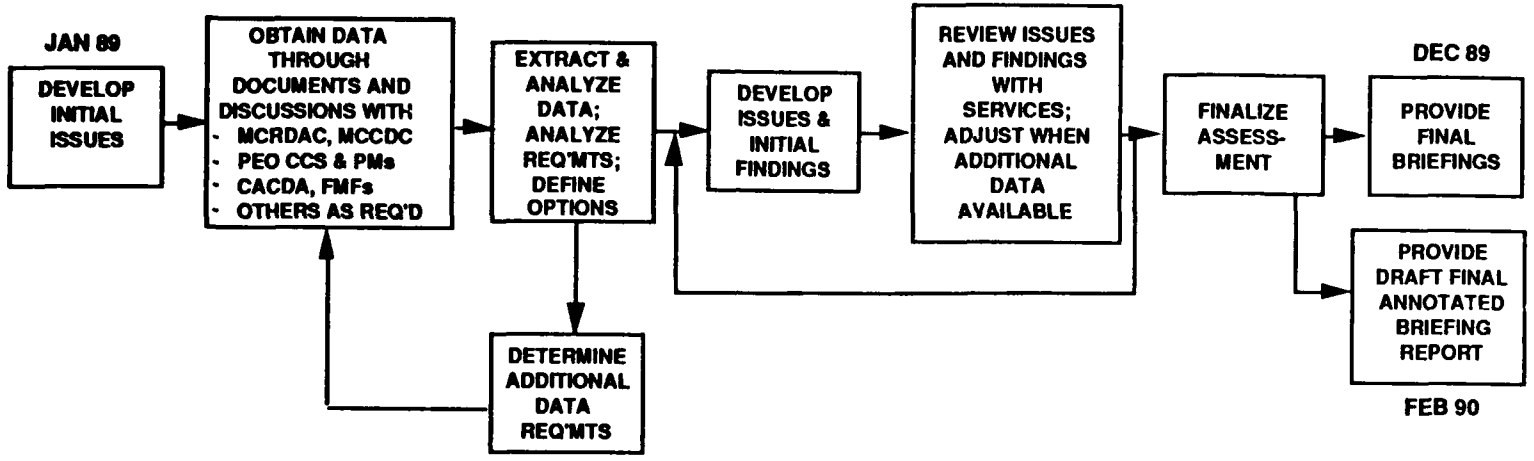
The technical approach for this task includes two cyclic activities: one to obtain and analyze the data, and the other to extract and refine the issues. In both activities, the findings were discussed with the Services and, where appropriate, additional data were requested and incorporated. The final program briefing was provided to OSD on 20 December 1989. The data in this report are considered current as of 15 December 1989.

Frequent visits and numerous discussions were held with personnel from the Marine Corps Research, Development, and Acquisition Command (MCRDAC), especially the Program Manager (PM) for Marine Air-Ground Task Force (MAGTF) C2, the PM for Communications and Navigation, and the PM for Aviation C2; the Marine Corps Combat Development Command (MCCDC); the C4 Systems Division at Headquarters, Marine Corps (HQMC); the Marine Corps Tactical Systems Support Activity (MCTSSA); I Marine Expeditionary Force (I MEF); III MEF; and the 1st Marine Division (1st MARDIV).

Visits and discussions with the U.S. Army included the Program Executive Officer (PEO) for Command and Control Systems (CCS) and the PMs for Field Artillery Tactical Data Systems (PM FATDS), Operational Tactical Data Systems (PM OPTDS), Air Defense Command and Control Systems (PM ADCCS), and Common Hardware and Software (PM CHS); the Chief of the Air Defense Artillery (ADA) C3I Division in the Directorate of Combat Developments at the U.S. Army Air Defense Artillery School; the Headquarters, Department of the Army (HQDA) Directorate of Information Systems for C4; TRADOC System Manager Fire Support C3 at Fort Sill; and the Combined Arms Combat Development Center (CACDA) at Fort Leavenworth.

The IDA study team met with representatives of the Joint Tactical C3 Agency (JTC3A) and observed the Joint air defense exercise Roving Sands 1989 at Fort Bliss (Army, Marine Corps, and Air Force participation). Representatives from the Center for Naval Analyses, Pacific Northwest Laboratories (PNL), Litton Data Systems, Magnavox Electronic Systems Company, and several Marine Corps and Army operational units have also been included in technical discussions.

APPROACH AND SCHEDULE



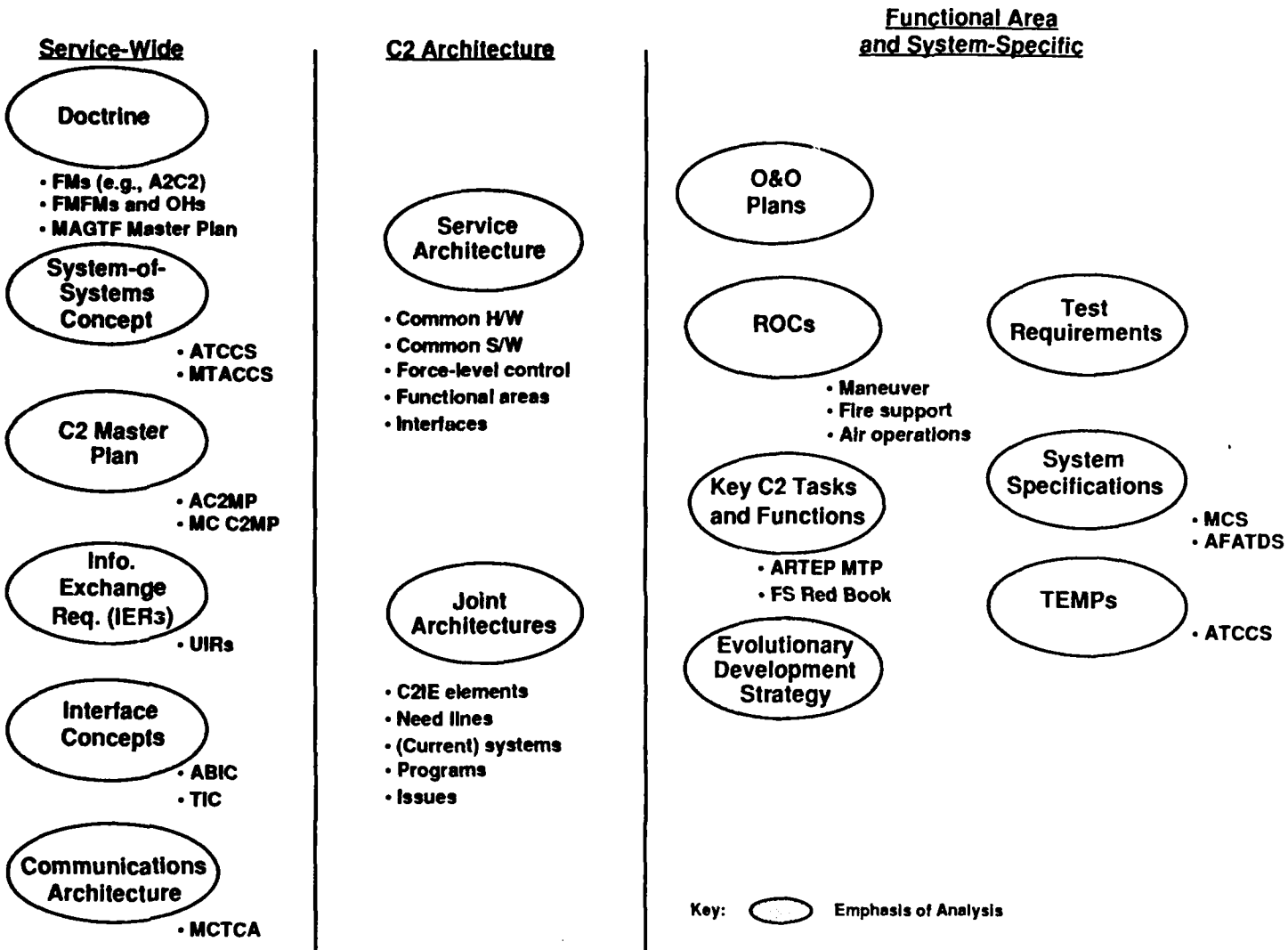
RPW 11-26-89-15

A wide range of requirements sources were examined in connection with this assessment. These are illustrated and grouped in the chart. Sources that were emphasized in the study are shaded. The broadest group of Service-wide documents is at the left. These include statements of doctrine--such as the Army Field Manuals (FMs), Fleet Marine Force Manuals (FMFMs), and Operational Handbooks (OHs)--and the Marine Air-Ground Task Force (MAGTF) Master Plan. Descriptions and (in the case of the Army) requirements documents were examined for both Services' system-of-systems concepts: the Army Tactical Command and Control System (ATCCS) and the Marine Tactical Command and Control System (MTACCS). Key documents for intra-Service interoperability requirements included the Army Battlefield Interface Concept (ABIC) and the Marine Corps' Technical Interface Concept (TIC). Both Services have command and control master plans (C2MPs)--the Army C2MP is very general, while the Marine Corps C2MP is detailed but out of date. Only the Army has formalized the specification of information exchange requirements between functional areas and systems, documented in a series of User Interface Requirements (UIRs), not all of which have been approved by CACDA and HQDA. The Marine Corps Tactical Communications Architecture (MCTCA) identifies all the nets and subscribers for data and voice communications.

Both Services have developed C2 architectures for tactical systems that address common hardware and software (CHS), force-level control requirements, tactical data systems with each of the functional areas (the Marine Corps has four functional areas and the Army five), and system interfaces among the C2 systems. Joint Functional Interoperability Architectures (FIAs) have been developed by JTC3A, validated by the Joint Staff, and approved by OSD in mission areas such as Fire Support and Air Defense and Airspace Control. The FIAs identify command and control Information Exchange (C2IE) elements involved in Joint operations and specify the interface need lines, systems (primarily current systems) to be employed, Joint interoperability issues, and programs underway to address the issues.

Sources of requirements for systems and concepts in specific functional areas considered in the study included the Service organizational and operational (O&O) plans and required operational capability (ROC) statements. User specifications of the key C2 tasks and functions to be performed with and without ADP support were reviewed where available. These include the Army Training and Evaluation Plan (ARTEP), Mission Training Plan (MTP), and the "Red Book" of fire support functions developed by the Field Artillery School. Other documentation included development plans and strategies, system specifications, test requirements, and test and evaluation master plans (TEMPs).

IDENTIFICATION OF C2 ADP SUPPORT REQUIREMENTS



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1. SYSTEM CONCEPT ASSESSMENT

The system concept assessment begins with a summary of the functional areas and key control systems in each of the two Service's system-of-systems concepts: ATCCS and MTACCS. This background is followed by a summary of the concepts and approach being used by the Army and Marine Corps to acquire common hardware and software (CHS) for C2 systems and a summary of the status of the Service's key C2 control systems. The section concludes with a summary assessment and conclusions.

Additional information on ATCCS derived from the ROCs and the ABIC is provided in Appendix C. Appendix D provides additional information on MTACCS that is derived from ROCs, the draft revised MTACCS concept, the Marine Corps C2MP, and the TIC.

SYSTEM CONCEPT ASSESSMENT

- SYSTEM-OF SYSTEMS CONCEPTS: ATCCS, MTACCS
- COMMAND HARDWARE AND SOFTWARE
- STATUS OF C2 CONTROL SYSTEMS
- ASSESSMENT
- CONCLUSIONS

RPW-12/15/89/1

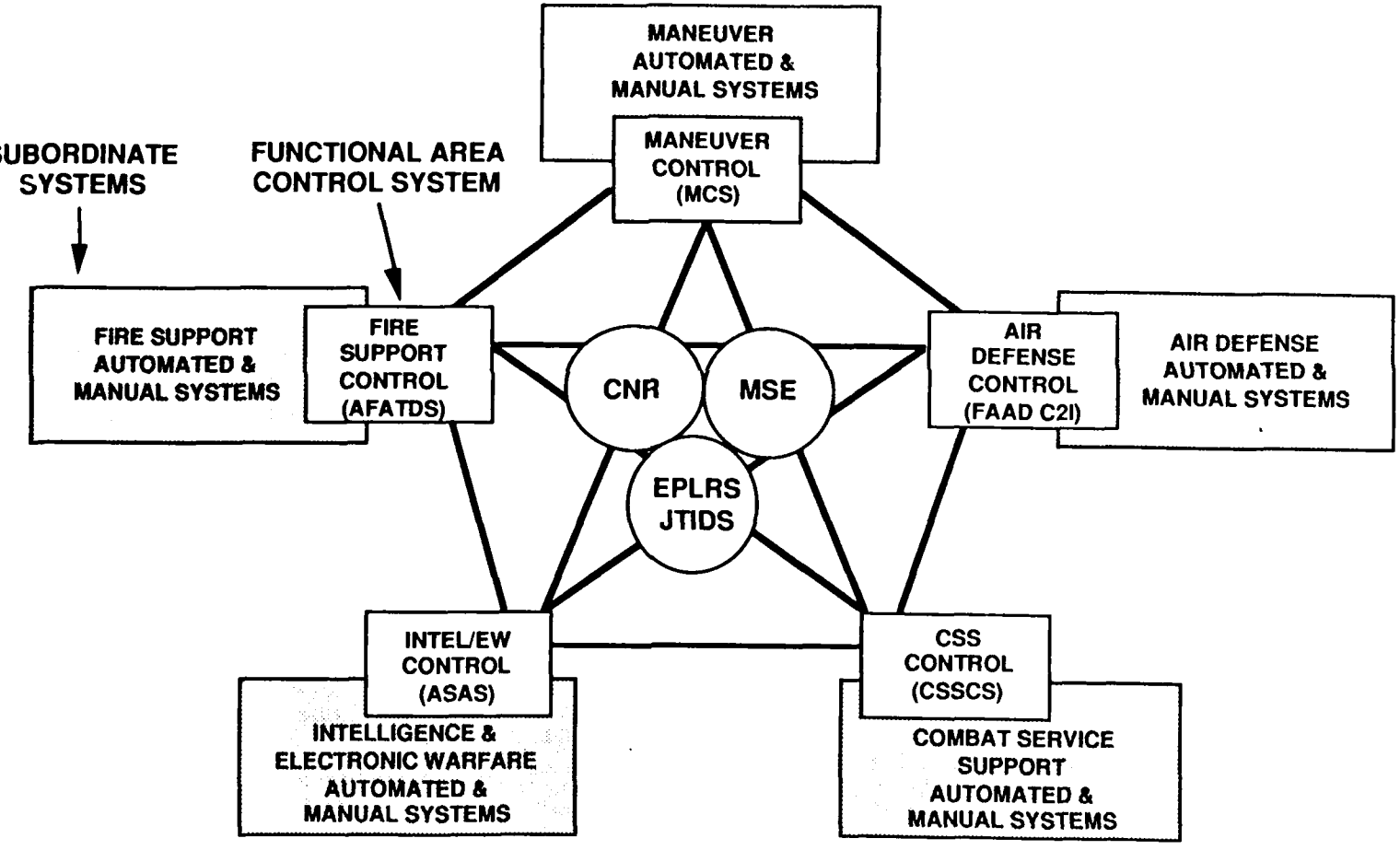
ATCCS is the Army's tactical system-of-systems concept. As shown in the chart, the tactical systems are grouped into five battlefield functional areas (BFAs): maneuver control, fire support, air defense, intelligence and electronic warfare (IEW), and combat service support (CSS). Each functional area is planned to have a single BFA control system and a number of subordinate automated and manual BFA systems. The objective control systems are:

- Maneuver Control System (MCS). MCS has been fielded on militarized hardware called the Tactical Computer Terminal (TCT) and nondevelopmental item computers called the Tactical Computer Processors (TCPs). Fielding with the ATCCS CHS is planned with the next version (V11) of the evolutionary development program, planned for FY93. A theater-level maneuver control system, U.S. Army in Europe (USAREUR) Tactical Command and Control System (UTACCS), has been fielded in Europe.
- Advanced Field Artillery Tactical Data System (AFATDS). AFATDS completed concept evaluation (CE) in 1989 and will begin full scale development in 1990. When fielded with ATCCS CHS beginning in FY94, AFATDS will replace the Tactical Fire Direction System (TACFIRE), now being used in the heavy divisions, and the Lightweight TACFIRE (LTACFIRE) now being fielded to the light divisions.
- Forward Area Air Defense (FAAD) Command, Control, and Information (C2I). FAAD C2I is a tactical data system being developed with ATCCS CHS that will develop and distribute a low-altitude air defense (LAAD) air picture and C2 information across a division front. Its IOC is planned for FY94.
- All Source Analysis System (ASAS). ASAS is being developed in the Joint Tactical Fusion program with the Air Force, whose system is called Enemy Situation Correlation Element (ENSCE). A limited capability configuration (LCC) for ASAS is planned for FY93. When fielded, ASAS will replace the Technical Control and Analysis Center (TCAC, AN/TSQ-130) that is being used in some heavy divisions in the United States and in Europe. Initially, ASAS will not be fielded with ATCCS CHS.
- Combat Service Support Control System (CSSCS). CSSCS will provide a tactical interface to CSS systems deployed to the Continental United States, used in garrison, and fielded for tactical employment. A prototype CSSCS is now under development, but full-scale development of the objective system has not yet begun. IOC with ATCCS CHS is planned for FY94.

Supporting ATCCS are three types of communications systems. The first is single-channel combat net radio (CNR). The Army has fielded VHF/FM radios such as the AN/PRC-77 and AN/VRC-12 family of radios and is fielding a replacement Single-Channel Ground-Air Radio System (SINCGARS). The second type is a switched system called the Mobile Subscriber Equipment (MSE), a military version of cellular radio based on the French-developed RITA system. A packet-switched data communications overlay for MSE has been approved as a preplanned product improvement, but is not funded. The third type of communications is called the Army Data Distribution System and consists of the Enhanced Position Location Reporting System (EPLRS) and the Joint Tactical Informations Distribution System (JTIDS). The data rate for EPLRS will be 2,400-3,600 bits/sec.

System Concept Assessment

ARMY TACTICAL COMMAND AND CONTROL SYSTEM (ATCCS)



RW 11/21/89-11

A key feature of the ATCCS program is the goal of using CHS for the five tactical BFA control systems wherever possible. This chart identifies the primary hardware components and identifies in some detail the objective concept for the layers and modules of common software. Modules for all layers would be candidates for automated systems other than BFA control systems as these are developed or improved during the 1990s.

Layer 1 is the common hardware. The ATCCS computers--the Portable Computer Unit (PCU) and the Transportable Computer Unit (TCU)--are based on a 32-bit Motorola 68020 microprocessor,[3] a 32-bit, 5 Mbits/s data bus, a 3.5-in floppy disk drive, and a 40- or 100-Mbyte removable hard disk cartridge. The PCU supports 1-2 million instructions per second (MIPS) and 4-20 Mbytes of random access memory (RAM), whereas the TCU supports 2-4 MIPS with 4-16 MBytes of RAM. The Stand-Alone Display Unit (SDU) is a 16-in monitor with two[4] configurations: monochrome display with a direct (RS-232) connection to a PCU or TCU or color monitor device (CMD) with keyboard and connection to the standard (ISO 8802.3) local area network (LAN). The PCU has a 25-line (9-in) built-in display. The stand-alone Hard Disk Unit (HDU) is a 152-Mbyte disk drive with an Institute of Electrical and Electronics Engineers (IEEE) 488 interface. The Adaptive Programmable Interface Unit (APIU) provides four modems with multiple interface options (e.g., wire, RS-232, RS-449, COMSEC, combat net radio, packet switching). The Handheld Terminal Unit (HTU), designed as a digital entry device for forward units, weighs 7-10 lb and supports up to four modems. CHS needs to be down-sized--workstations composed of CHS planned for AFATDS weigh 250-450 lb.

Common software is planned for system support (Layer 2), common applications software support (CASS, Layer 3), and C2 applications software (Layer 4). Layer 2 software is provided with the NDI hardware and includes both UNIX and MS DOS environments (HTU supports only MS DOS). Layer 2 has an Ada environment with programming support tools and standard tools accessible via bindings in Ada for graphics [e.g., Graphics Kernel System (GKS) and database management (e.g., Starbase and SQL query interfaces)]. Layer 2 also provides handlers and access codes for the communications hardware and software (e.g., APIU, LAN).

The CASS making up Layer 3 has not yet been developed, although there are a number of promising candidates already coded in MCS and AFATDS. A high-level working group has been formed by the PEO-CCS to advance CASS specification and development. Work is currently focused on requirements for Inter-Task Communications (ITC), using the design and software from the AFATDS Concept Evaluation (CE) as a baseline. Work is also ongoing in the Soldier-Machine Interface (SMI) and System Manager (SM) areas. The goal of the PEO-CCS is to have as much CASS in the next versions (in 1993) of MCS and AFATDS as possible.

Most of the C2 applications software in Layer 4 could be unique to a battlefield functional area (BFA), but these would be designed with the goal of being able to use the modules at any workstation. This would enable any properly configured CHS workstation to execute modules from two BFAs where required (such as for modules for both fire support and maneuver or for both fire support and force level control). Modules such as tools to support continuity of operations (CONOPS), training, database update, and database views could be used by several, if not all, the functional areas control systems.

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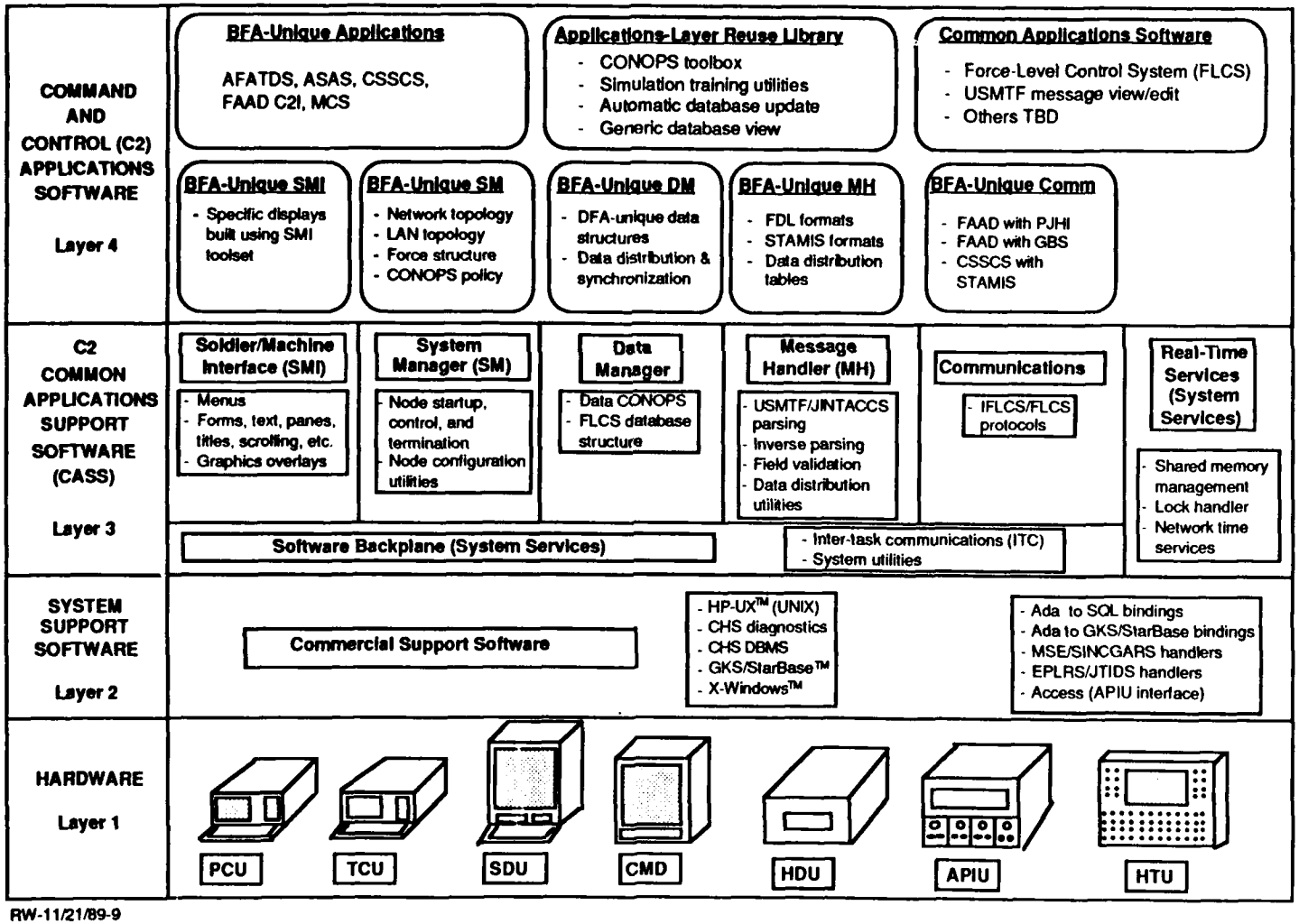
3 A 68030 microprocessor is optional, supporting up to 8 MIPS (at a 33 MHz clock rate).

4 Other options include 16- or 19-in high-resolution color monitor with 8 planes (the standard is 6 planes). A 12-in, 4-plane option is also available.

System Concept Assessment

ATCCS COMMON SOFTWARE (OBJECTIVE CONCEPT)



RW-11/21/89-9

For the system concept assessment, the IDA study team was provided a draft of a revised description of the MTACCS concept. The revised concept differs from the one defined in the MCC2MP in that one[5] of the tactical C2 systems is specifically assigned the role of a force-level control system to support MAGTF-level C2. Central to MAGTF C2 is ADP support for a MAGTF Database developed from information provided in the four functional areas. These are Ground C2, Aviation C2, CSS C2, and Intelligence. MAGTF C2 provides support to the Commander for information fusion, dissemination, and display; planning; assessment; and tasking.

The Ground C2 functional area includes maneuver control and fire support, as well as integration of position location information (PLI). Aviation C2 includes offensive and defensive air support, to include fixed-wing and rotary wing vertical takeoff and landing (VTOL) assault support and antiair warfare (AAW). In addition, Aviation C2 includes control of aircraft and missiles, electronics warfare, and air reconnaissance. CSS C2 provides visibility to the MAGTF and other functional areas as required on logistic assets and manpower. Intelligence supports MAGTF C2 by providing information on enemy positions, orders or battle, and maneuver indicators.

Supporting MTACCS are the communications for data and voice, as required. The systems included in communications as well as the four functional areas are identified on the next chart.

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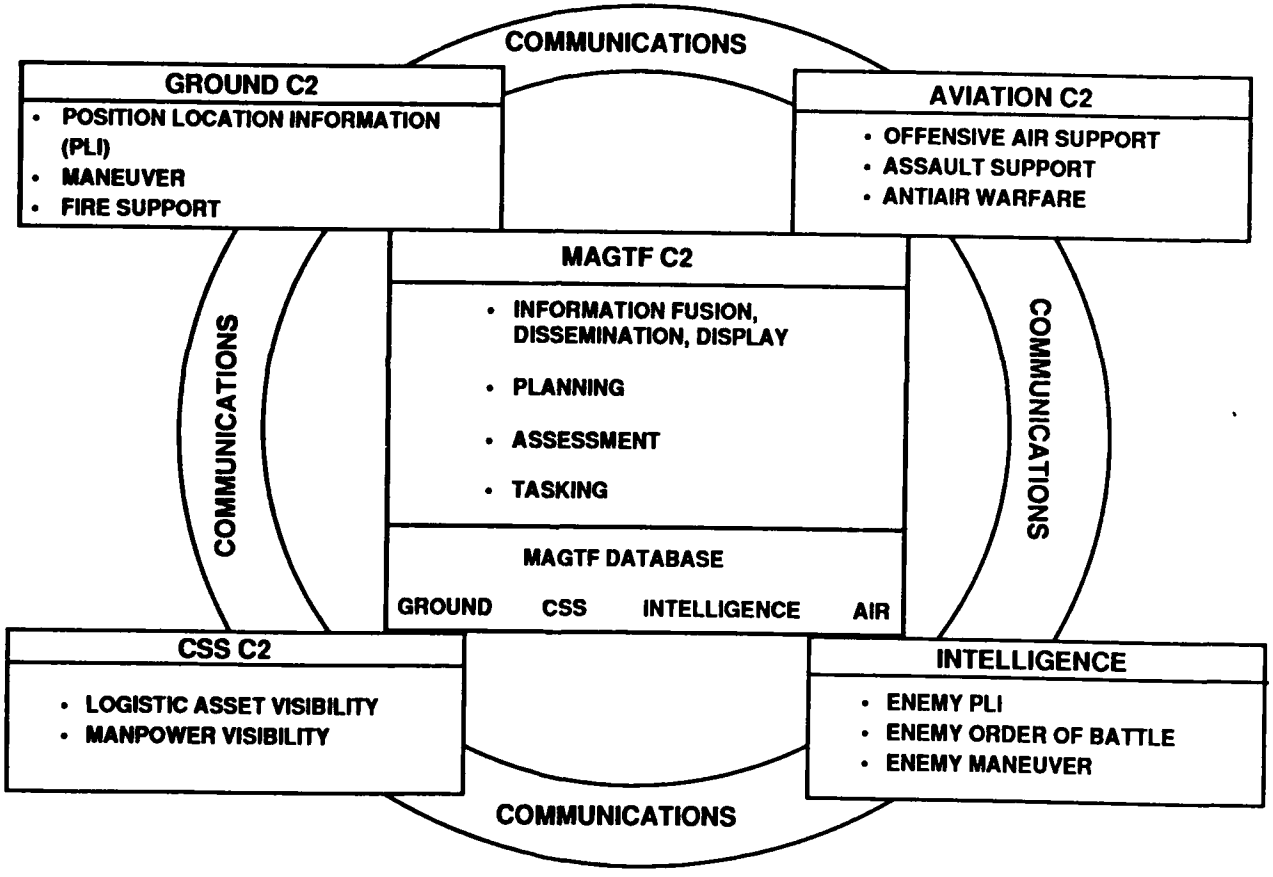
5 Tactical Combat Operations (TCO).

System Concept Assessment

MARINE TACTICAL COMMAND AND CONTROL SYSTEMS (MTACCS)--FUNCTIONAL AREAS



Source: *MTACCS*, Draft, PM Ground/CSS C2, MCRDAC, November 1989.

RW-11/21/89-1

MTACCS includes systems to be employed and retained afloat as well as those to be deployed ashore. The chart shows conceptual and developmental as well as fielded systems. Supporting Amphibious Warfare C2 are ship systems such as the Integrated Tactical Amphibious Warfare Data System (ITAWDS), the systems such as the Flag Data Display System (FDDS, AN/USQ-88) that are included in the Tactical Flag Command Center (TFCC) program, and the Shipboard Marine Remote Area Approach and Landing System (SMRAALS).

TCO is the system that supports the MAGTF C2 and the MAGTF Database. Three systems will provide the primary ADP support of Ground C2: Fire and Maneuver System (FIREMAN), Flexible Fire Support System (FIREFLEX), and Position Location Reporting System (PLRS, AN/USQ-90). FIREMAN would support maneuver control, FIREFLEX the employment of fire support, and PLRS the integration of PLI.

Aviation C2 consists of a family of C2IE elements and tactical data systems called the Marine Air Command and Control System (MACCS). The major tactical data systems are the ATACC, TAOM, IDASC, and the Marine Air Traffic Control and Landing System (MATCALS). ATACC supports the Air Command Element (ACE) Commander and the ACE Commander's staff in planning and executing air operations. Engagement operations of air defense systems are conducted with one or more (usually three) TAOMs. Voice coordination is used in the TAOM to alert, where possible, units engaged in low-altitude air defense (LAAD). Coordination of close air and assault support is conducted with the IDASC, which today has no ADP support for C2 (the Communications Control Panel developed in the MIFASS program is used to support analog and digital voice communications). MATCALS provides air traffic control services for a radius of 60 nmi, supported by the AN/TSQ-107 surveillance radar and data links to other nodes and aircraft.

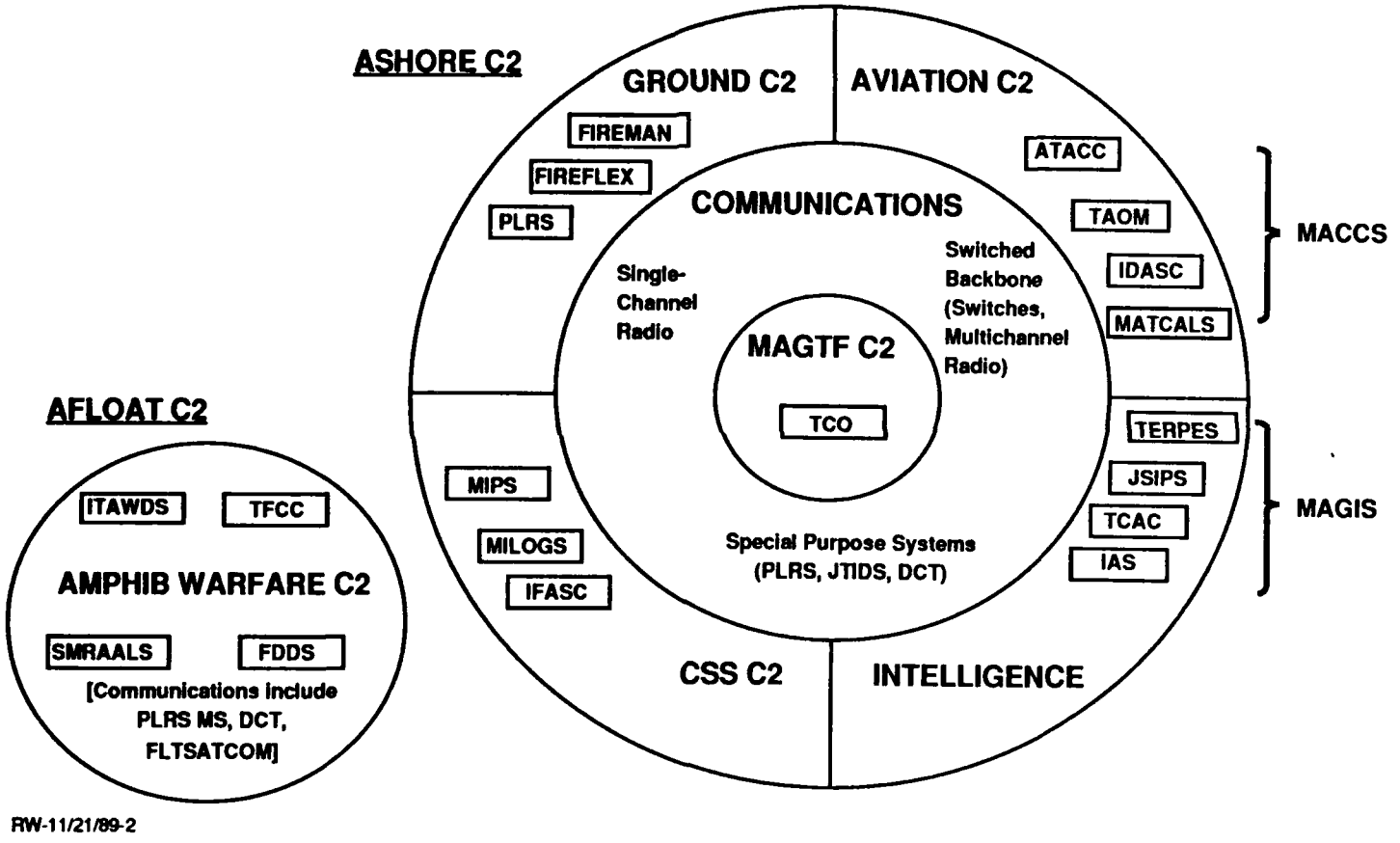
CSS C2 systems included in MTACCS are the Marine Integrated Personnel System (MIPS), Marine Integrated Logistics System (MILOGS), and the Improved Force Automated Services Center (IFASC). These systems run on standalone microcomputers and minicomputers and rely on exchange of physical media (tapes, diskettes) for interoperability. Software for MIPS and MILOGS is being ported to the Fleet Marine Force (FMF) End-User Computing Equipment (EUCE, AN/UYK-83), an IBM PC AT™-compatible microcomputer system.

Intelligence support is provided by the Intelligence Analysis System (IAS), Tactical Electronic Reconnaissance Processing and Evaluation System (TERPES, AN/TSQ-90), TCAC, and the Joint Service Imagery Processing System (JSIPS).

There are three classes of supporting communications systems. Single-channel radio (SCR) includes VHF/FM radios such as the AN/PRC-77 and AN/VRC-12 family of radios and the Single-Channel Ground-Air Radio System (SINCGARS); HF radios such as the AN/MRC-138; and UHF radios such as the AN/GRC-171. The second class of communications is called the Switched Backbone (SBB). It includes voice switches; circuit switches, such as the Unit Level Circuit Switch (ULCS); and the Unit Level Tactical Data Switch (ULTDS). The ULTDS, formerly known as the TRI-TAC Unit-Level Message Switch, has been approved for procurement, but there is an initiative to integrate the ULTDS capability into the ULCS as a preplanned product improvement (P3I) as an alternative to fielding two separate switches. The third class of communications consists of special purpose systems such as the Joint Tactical Information Distribution System (JTIDS). This class also includes PLRS and may include the Digital Communications Terminal (DCT, AN/PSC-2).

System Concept Assessment

MTACCS--TACTICAL DATA SYSTEMS



RW-11/21/89-2

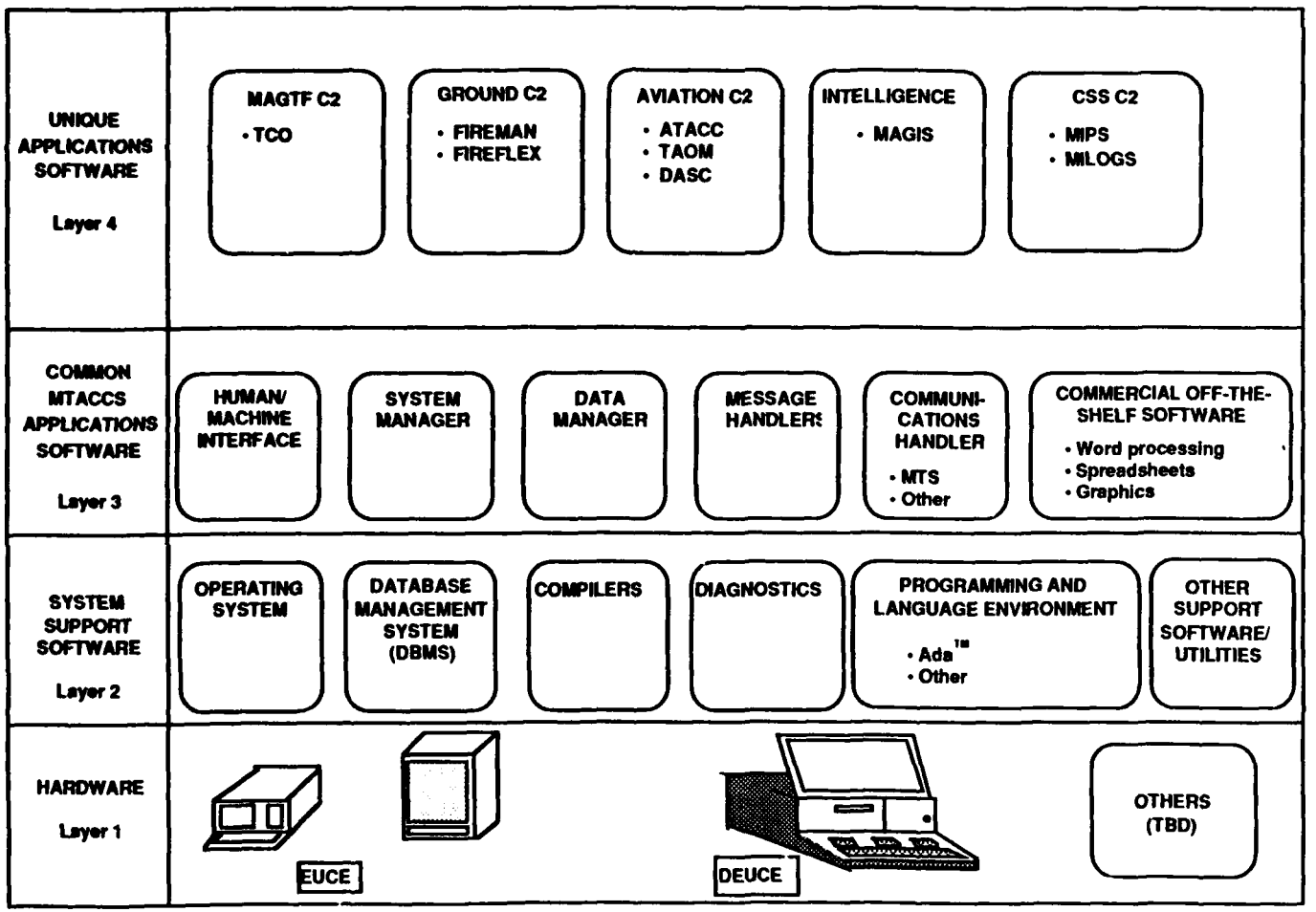
The draft revised MTACCS concept explicitly identifies the goal of common software in the objective C2 systems in the same four layers as identified by ATCCS. The elements identified to date for MTACCS are shown in the chart. Elements of the Army's CHS are now being evaluated (the Marines have bought CHS to configure about 12 workstations for this evaluation). However, a decision to include the Army CHS in Layer 1 has not been made. The EUCE has already been fielded, and software is being converted to Ada for tactical applications to be run on the EUCE. The Downsized End User Computer (DEUCE) is ready for fielding.

FMF initiatives for the Marine Corps are based, in large part, on commercial software developed in off-the-shelf software that could be designated for the objective communications software concept. ORACLE and other software packages for database management and information transfer are being evaluated.

Several C2 systems identified in the previous chart are not explicitly cited in Layer 4. Applicability to subsystems of MAGIS, MATCALS, PLRS, and IFASC is still being considered by the Marine Corps.

System Concept Assessment

MTACCS COMMON SOFTWARE (OBJECTIVE CONCEPT)



RW-11/21/89-10

This chart identifies the developmental status of the key command and control systems for the two Services. Only the BFA control and high- and medium-altitude air defense (HIMAD) C2 systems are shown for the Army. Only the systems explicitly identified in MTACCS as control systems or data systems directly interfacing to the MAGTF database are shown for the Marine Corps.

Two HIMAD control systems have been fielded by the Army: the PATRIOT Information Coordination Central (ICC) and the AN/TSQ-73 MISSILE MINDER for HAWK C2. The MCS has been fielded on the TCT and TCP equipment. The TCAC is the current IEW technical control system for several Army units in the United States and the U.S. Army in Europe (USAREUR). Four BFA control systems are still in early stages of development, with initial operational capabilities (IOCs) planned for FY93 to FY94: AFATDS, ASAS, CSSCS, and FAAD C2I. In addition, the MCS will be ported to CHS and provided with an initial force-level control capability with an IOC in FY93.

Three of the Marine Corps systems are still in the conceptual stage with testbed prototypes. The testbeds for FIREMAN and TCO are at Camp Pendleton (I MEF). Fire support testbeds are also being developed at Camp Pendleton and Camp Lejeune (II MEF). IDASC has no ADP support yet. The FIREFLEX program is currently directed at AFATDS as the objective system, with fielding soon after the Army IOC in FY94. A contract has been awarded for the ATACC, whose development will include the use of NDI equipment and software. Five of the Marine Corps control systems have been procured and their fielding has begun or been completed: MATCALS, PLRS, TAOM, TCAC, and TERPES.

Highlighted in the chart with boxes are the systems identified by the IDA study team as primary candidates for cross-Service commonality. Three of the systems are in the CSS functional area: CSSCS, MILOGS, and MIPS. Since assessment of ADP support for combat service support is outside the scope of the current task, opportunities for exploiting commonality of these systems was not further considered in the IDA study.

The potential for commonality for maneuver control and force level control systems (TCO, MCS, FIREMAN) is addressed in the maneuver control assessment that follows this section. The fire support assessment addresses the potential for commonality for AFATDS and FIREFLEX. IDASC is addressed in the discussion of air operations, but it will benefit from use of ADP capabilities discussed for maneuver and fire support.

System Concept Assessment

STATUS OF MAJOR C2 SYSTEMS FOR ARMY AND MARINE CORPS

	CONCEPTUAL WITH TESTBED PROTOTYPES	DEVELOPMENTAL (ESTIMATED IOC)	FIELDED
ARMY		• AFATDS (FY94)	MCS-TCT/TCP
		ASAS (LCC FY93)	PATRIOT ICC
		• CSSCS (FY94)	TACFIRE
		• FAAD C2I (FY94)	TCAC
		• MCS-CHS (FY93)	TSQ-73 (HAWK C2)
MARINE CORPS	o FIREMAN[1]	ATACC (FY92)	MATCALS
	o TCO	• FIREFLEX/AFATDS (FY94)	PLRS
	IDASC	IAS[1]	TAOM
		IFASC	TCAC
		JSIPS	TERPES
		* MILOGS[1]	
		* MIPS[1]	

Key: • Plans to use Army CHS
* Plans to use FMF EUC
o Both Army CHS and FMF EUC are being considered
□ Systems where subsystem commonality has the greatest potential across the Services

[1] Draft ROCs have not yet been approved.

RPW-12-18-89-5

This section concludes with a high-level assessment of the ATCCS and MTACCS system-of-systems concepts. Both concepts have been evolving for a number of years--MTACCS since 1979[6] and ATCCS since 1985. The Army now has an approved ATCCS ROC and approved ROCs for all five control systems (AFATDS, ASAS, CSSCS, FAAD C2I, and MCS) issued as annexes to the ATCCS ROC. The last of these (FAAD C2I) was approved in October 1989. The MTACCS concept is now undergoing revision that clarifies the roles of TCO, FIREMAN, FIREFLEX, and the other systems. Although not yet approved by MCCDC nor introduced formally into the FMF, the revised MTACCS concept appears to be a sound basis for an overall system architecture.

Both MTACCS and ATCCS treat communications as supporting systems, not part of the system itself, and both emphasize common-user communications for exchange of data by analog and digital means. Each Service plans to use NDI components and modules, using commercial off-the-shelf sources where feasible and exploiting commonality where possible. Applications software is planned to be modular, layered, and written in Ada. The Army has selected an initial set of CHS on a 5-year contract and provides for low-cost technology insertion. The Marines have some hardware (EUCE, DEUCE) and are evaluating other candidates (e.g., laptops, Army CHS).

Each Service addresses requirements for Joint and Combined interoperability, as well as intra-Service interoperability. However, achieving the required Joint and Combined interoperability is frequently postponed to later stages of the evolutionary development process. The Marine Corps, for example, places emphasis on TCO and FIREMAN for NATO interfaces (no NATO interfaces are cited in the Marine Corps TIC for fire support), but the testbed versions of these two systems have no support for NATO interfaces.

The systems in both MTACCS and ATCCS, particularly those supporting force level control (TCO and MCS), emphasize a high-level database and selected cross-functional information exchange to support staff planning and the Commander's decisionmaking. However, neither Service has a data model that spans the functional areas and ensures that implementations of databases in the various control systems can easily be made to interoperate. However, the Army has a new regulation (AR 25-9) that will lead to Army wide management of data elements; this is a valuable step in the data management process necessary to reach C2 interoperability.

Neither Service has specific plans to support the automated exchange of information among tactical data systems (TDSs) of different functional areas to support force level control (e.g., interface between MCS and AFATDS) and other operational requirements until at least 1995. Indeed, MCS will not achieve this automation (to replace swivel-chair interfaces) until Version 12, whose IOC is 1995, unless some unexpected progress is made in the next year or two in CASS and Layer 4 common software. This capability for TCO is still to be determined (TBD). The Marine Tactical System (MTS) messages are developed to a common standard (and common bit-oriented protocols), but these are used primarily to support functions within single functional areas.

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6 The General Operational Requirement (GOR CC-9) that led to MTACCS was published in July 1967.

System Concept Assessment

ASSESSMENT OF ARMY AND MARINE CORPS SYSTEM-OF-SYSTEMS CONCEPTS

- ATCCS has a unifying approved ROC with annexes for 5 developmental C2 systems
- Revised MTACCS concept not yet approved by CG MCCDC or introduced to the FMF, but appears to be a sound basis for an overall system architecture
- Both ATCCS and MTACCS treat communications as supporting systems and emphasize common-use digital communications
- Each plans to use common NDI hardware and common, modular, and layered software, using commercial off-the-shelf components where feasible–the Army has selected an initial set of common hardware and software; some is being considered for use in the Marine Corps
- Each addresses Joint and Combined interoperability, but achieving these requirements is frequently postponed to later stages of evolutionary development
- Each emphasizes a high-level database and selected cross-functional information exchange to support staff planning and Commander's decisionmaking
- Neither Army nor Marine Corps has specific plans to support automated information exchange among TDSs for force-level control until at least 1995 (MCS in Version 12, TCO is TBD)
- Work to develop common applications support software could lead to substantial cost savings and enhanced interoperability, but needs to be carefully managed

RW-11/21/89-7

In summary, ATCCS and MTACCS both have the potential to improve intra-Service interoperability and to reduce acquisition (development and procurement) costs. However, automated information exchange across functional areas within each Service will not be achieved before the mid-1990s.

System Concept Assessment

CONCLUSIONS

- ATCCS AND MTACCS PROVIDE OPPORTUNITIES TO IMPROVE INTRA-SERVICE INTEROPERABILITY AND REDUCE ACQUISITION COSTS

- AS PLANNED NOW, AUTOMATED INFORMATION EXCHANGE ACROSS FUNCTIONAL AREAS FOR ARMY WILL NOT BE ACHIEVED BEFORE MID-1990s (TBD FOR MARINE CORPS)

RPW-12-18-89-7

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2. MANEUVER CONTROL ASSESSMENT

The maneuver control assessment begins with an overview of the steps taken in the assessment and provides background on the status of the Marine Corps' FMF initiatives and the Army's MCS. This background is followed by a summary of the consolidated requirements and the associated driving requirements developed as part of the analysis. The overall assessment of the system options against the driving requirements is followed by a statement of issues and options for the Marine Corps and, finally, the conclusions.

MANEUVER CONTROL ASSESSMENT

- STEPS IN ASSESSMENT
- CONSOLIDATED REQUIREMENTS
- DRIVING REQUIREMENTS
- STATUS OF MARINE CORPS INITIATIVES AND MCS
- ASSESSMENT OF SYSTEM OPTIONS
- ISSUES
- OPTIONS FOR MARINE CORPS
- CONCLUSIONS

RPW-12/15/89/2

This chart shows the steps taken by the IDA study team in assessing the maneuver control functional area. The first two steps are discussed below, and the others are addressed in detail in the charts that follow.

The maneuver control assessment began by reviewing all the requirements developed by the Army and the Marine Corps and validated in Required Operational Capability (ROC) statements for TCO, FIREMAN, and MCS. The MCS ROC was revised and approved in September 1989. The TCO ROC was originally approved in August 1978; a draft revision prepared in 1986 was not approved. A FIREMAN ROC has been developed by MCCDC and is in the final stages of review at MCCDC. The requirements review resulted in the development of a compilation, provided in Appendix A, of functional, interface, and physical characteristic requirements.

In an effort to identify requirements not explicitly contained in the ROCs but considered essential to developing ADP support for maneuver command and control, the IDA study team reviewed a number of additional requirements statements. These included the Army's UIRs that define information exchange among the control systems of the five functional areas for the Army (no comparable source was found for the Marine Corps); the ABIC; the Marine Corps' TIC; information exchange requirements (IERs) and key tasks defined for tactical C2 systems in Allied Command Europe; the descriptions and architectures underlying both ATCCS and MTACCS; and the specifications, where available, of the functional tasks and activities performed by the two Services in support of maneuver control. In addition, drawing on IDA's experience in providing analytic and technical support for requirements and concepts being developed for interoperable C2 systems for SHAPE in the Year 2000 and beyond, IDA reviewed the generic C2 requirements from the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) study.

A high degree of commonality among the Service requirements for ADP support of maneuver control C2 was found, and a list was prepared (see Appendix B) of the consolidated generic capability represented by the common requirements. From this consolidated generic capability statement, nine requirements were identified as "driving requirements," in the sense that they were fundamental to a basic operational capability and that they appeared to be key to decisionmaking in evaluation system options for maneuver control. These driving requirements were reviewed by representatives of the Services, but are considered validated only for the purpose of this assessment.

The IDA study team compared each of the driving requirements to the capabilities provided or planned in the system options identified: Versions 10, 11, 12, and 13 of MCS and the capabilities inherent in the Marine Corps Fleet Marine Force (FMF) initiatives. From the analysis of system options, a number of issues and potential actions were identified for refining the requirements and developing an acquisition program.

Maneuver Control Assessment

STEPS IN MANEUVER CONTROL ASSESSMENT

- DEVELOPED A REQUIREMENTS SUMMARY THAT INCLUDES THE FUNCTIONAL REQUIREMENTS CONTAINED IN TCO, FIREMAN, AND MCS ROCs
- REVIEWED OTHER STATEMENTS OF REQUIREMENTS, INCLUDING:
  - Army user interface requirements (UIRs)
  - Interface concepts: ABIC, TIC
  - IERs and key tasks defined for Allied Command Europe
  - System of system concepts and Service architectures: ATCCS, MTACCS
  - Specification of functional tasks and activities: ARTEP MTP, OH-6-1, JCS Pub 1
  - Generic command and control requirements (from ATCCIS, a SHAPE-sponsored study)
- EXTRACTED A CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL AND HIGHLIGHTED POTENTIAL DRIVING REQUIREMENTS
- COMPARED GENERIC CAPABILITY TO SYSTEM SPECIFICATIONS TO DETERMINE THE EXTENT TO WHICH SERVICE PROGRAMS MEET THE POTENTIAL DRIVING REQUIREMENTS
- IDENTIFIED REQUIREMENTS-ORIENTED AND PROGRAMMATIC ISSUES
- PREPARED A SET OF POTENTIAL ACTIONS THAT COULD BE TAKEN TO ADDRESS MARINE CORPS REQUIREMENTS FOR MANEUVER CONTROL

RPW 11-22-89-13

This chart summarizes the consolidation of the common (generic) requirements derived by the IDA study team from review of the combined stated requirements of both the Army and the Marine Corps for maneuver control. As indicated earlier, the complete list of the combined requirements is provided in Appendix A and the consolidated generic capability requirements in Appendix B.

Both Services plan to support both maneuver control and force level control primarily by providing ADP support for information exchange and a common-user database. All of the specified functions are associated with deriving, manipulating, and displaying information that is maintained in the database. To support decisionmaking by the Commander and assessments by the Commander's staff, a high-level database is provided and maintained at the operations centers of the senior echelons. This high-level database is planned to be accessible to and updated from other tactical data systems. More detailed information is planned for the common-user database maintained elsewhere for other staff functions and for functions specific to one of the functional areas.

The database is required to support automatic updates and to be capable of receiving, transmitting, editing, storing, and displaying information as text, printed copy, graphics, and overlays. Updates and access to the database are to be selectively controlled, and ad hoc queries are to be supported.

Further, the system is to be designed to facilitate continuity of operations (e.g., echeloning, jump command posts, coordination among forward, rear, and main command posts) and to degrade gracefully when portions of the system or supporting communications become unavailable.

Finally, both Services require interoperability among systems in the maneuver control or Ground C2 functional areas, with systems of other functional areas of the same Service, and for Joint and Combined operations.

Maneuver Control Assessment

DEVELOPMENT OF CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL

- **DERIVED FROM COMBINED REQUIREMENTS OF MCS, TCO, AND FIREMAN ROCs**

- **SUMMARY**

  (1) Provide a common-user database with automatic update, capable of receiving, transmitting, editing, storing, and displaying information (including messages) as text, printed copy, graphics, and overlays

  (2) Provide selective control update and access to database and support ad hoc queries

  (3) Provide for continuity of operations and graceful degradation of capabilities

  (4) Provide interoperability

RPW-12-18-89-9

Nine of the requirements common to both the Army and the Marine Corps were identified by the IDA study team as "driving" requirements. Each of these requirements was assessed to be fundamental to a basic operational capability and to be key to decisionmaking for evaluating potential system options for ADP support of maneuver control. The driving requirements represent Service requirements that address the following issues:

- Is the planned automation support critical to the Commander or the Commander's staff?
- Is there support of critical information exchange requirements within MTACCS and with other Services and Allies?
- Can the required information exchange be supported with current and planned communications?
- Is the degree of difficulty to provide automation support cost effective in terms of developmental cost and time?
- Would physical characteristics impose a detrimental impact on mobility?

Careful review of the Service's evolutionary acquisition plans shows that the driving requirements are not all being given the same priority for development. Since both Services have development plans to implement automated support for the last three requirements in later stages of system evolution, these have been assessed by the IDA study team as being of somewhat lower priority than the others. To distinguish the classes of apparent priorities in the evaluation of system options (next chart), the first six (above the line) were labelled as Priority 1 and the last three as Priority 2.

Finally, it was observed that the MCS and TCO ROCs call for all nine requirements, whereas all but the requirement for cross-functional information exchange is specified for FIREMAN.

Maneuver Control Assessment

POTENTIAL DRIVING REQUIREMENTS FOR A MANEUVER CONTROL SYSTEM

- PROVIDE CAPABILITY TO PREPARE, RECEIVE, TRANSMIT, STORE, RETRIEVE, PRINT, AND DISPLAY INFORMATION TO INCLUDE MESSAGES, GRAPHICS, AND OVERLAYS
- PROVIDE A COMMON-USER DATABASE THAT SUPPORTS AUTOMATIC UPDATE FROM INFORMATION TRANSFER
- INFORMATION TRANSFER SUPPORTED BY EXISTING AND PLANNED COMMUNICATIONS
- PROVIDE SUMMARY AND DETAILED INFORMATION FOR RESOURCE STATUS OF SUBORDINATE UNITS (ROLL UP REPORTS)
- SUPPORT CONTINUITY OF OPERATIONS (CONOPS)
- PROVIDE EQUIPMENT EASILY TRANSPORTABLE BY USING UNIT

- SUPPORT AUTOMATED CROSS-FUNCTIONAL INFORMATION EXCHANGE
- SUPPORT JOINT INTEROPERABILITY AND PROVIDE GROWTH FOR COMBINED INTEROPERABILITY
- PROVIDE AUTOMATED INTERFACE FOR AND INTEGRATE PLI

RPW 11-22-89-4B

In the late 1960s, the Marine Corps developed the MTACCS concept as a means to automate functions in the areas of maneuver, fire support, tactical air operations, and personnel and logistics management. The program proceeded slowly throughout the 1970s and into the mid-1980s. A TCO testbed was one of the activities of this program. Following the cancellation of the MIFASS program in 1987, the MTACCS concept diminished in significance, and other approaches to solving the C2 automation problem have been attempted. To date, only a few of the planned systems to support MTACCS have been fielded (e.g., DCT, PLRS, TAOM).

As a result of the MIFASS experience, the Marine Corps decided that its approach to tactical automation for TCO and FIREMAN would be cautious, evolutionary, and include active participation by the Fleet Marine Forces (FMFs) in the field. With the approval of Headquarters Marine Corps (HQMC), field units have initiated local efforts to solve the C2 automation problem. FMF Initiatives are, for the most part, well coordinated within each MEF, but differ among the MEFs. The FMF Initiatives rely heavily on government-furnished personal computers and MS DOS-based commercial software programs.

FMF Initiatives for command and control automation currently consists of an electronic mail program that moves standardized messages and free text throughout a local area net. One of the file transfer programs is called the Commander's Situation Brief, which supports preparation and distribution of text and bit-image graphics. A LAN has been selected for the FMF Initiatives but it is based on a proprietary standard. This system is used in garrison and in the field. Work is underway to use a spreadsheet function to produce "roll-up" reports from subordinate units. A next planned step would be the acquisition of a commercial database system that can be updated from the current message processing system. Another area being examined is an enhancement to PLRS Automatic Location and Data Netting System (ALADNS), which is planned to improve the digital communications capability of PLRS, as well as provide an interface so that personal computers can perform some of the monitoring functions now only available in the PLRS master station. Some interoperability problems are presently attempting to be solved by use of liaison teams equipped with computers and software to provide a "swivel-chair" interface. Interface to the World Wide Military Command and Control System (WWMCCS) is also being examined.

Many users in the FMF have stated that the FMFs are progressing at as fast a pace as they desire to go at the present time. There is a strong feeling that they do not want to be rushed into a system that would cause a major change to their current course; nor do they desire a system that they were unable to assist in developing.

The requirements for maneuver control in the Marine Corps are based on the 1978 TOC ROC, which may still be valid under the new MTACCS concepts, and the draft FIREMAN ROC which has not yet been approved by MCCDC.

The Marine Corps plans to support increased standardization of FMF Initiatives throughout the three MEFs; continue R&D on an interface between personal computers (PCs) and PLRS, and communications enhancements such as ALADNS; and evaluate MCS V10.2 on existing hardware and, if possible, on ATCCS CHS.

Maneuver Control Assessment
STATUS OF MARINE CORPS INITIATIVES

- **FMF INITIATIVES**
  - Have been developed over many years, starting with the TCO Testbed
  - Are now well coordinated within each MEF, but differ among the MEFs
  - Rely heavily on NDI software packages for MS DOS personal computers
  - Include message handling, databases and files, and the Commander's Situation Brief (a file transfer utility)
  - Standardized command post data transfer on a proprietary LAN
- **REQUIREMENTS**
  - TCO ROC of 1978 may still be valid under new MTACCS concept
  - Draft FIREMAN ROC sent to FMF for comment, but is not yet approved by MCCDC
- **DEVELOPMENT PLANS**
  - Continue R&D on PLRS/PC interface and communications enhancements to PLRS
  - Evaluate MCS V10.2 on existing hardware and, if possible, on ATCCS CHS

RPW 11-26-89-9

The MCS fielded today is the result of a large number of development programs over the last 30 years. The Tactical Operations System (TOS) program developed the Tactical Computer Terminals (TCTs), and the Army later recommended procurement of NDI devices, the Tactical Computer Processors (TCPs). Both the TCTs and TCPs are in use today. The current version of software, Version 10 (V10), provides a wide range of information processing and decision support function, based on a common user database. In V10, this database consists of five files:

- Friendly information
- Enemy information
- Control measures
- Nuclear, biological, and chemical (NBC) information
- Obstacle barriers.

Message management processing in V10 includes support for automatic updating of the database from messages, manual updating, relaying information, queueing incoming messages, and controlling message acknowledgement (can be suppressed). Messages can be created, edited, and deleted.

Information processing extends beyond message management to include support of standing requests for information (SRIs), so that queries can automatically be activated when certain information-based parameters are met, when a time criterion is met, or when a certain type of message is received. Further, V10 supports development, storage, retrieval, and exchange of graphics and the display of a report for the Commander that summarizes with colored balls ("gum ball" chart) or colored sectors of a circle ("mercedes" chart) the status of various resources in supporting units (the information is rolled up and available when required for explaining deficiencies).

Data management in V10 underlying the information and message processing includes data dictionary support for descriptions, units, range, security, accuracy, precision, frequency, and other characteristics of the data elements. File management for the database includes control processing (e.g., initialization), update processing, replication, and querying processing. A dictionary of message files is maintained and support is provided for retrieving file messages based on operator-defined criteria.

Although V10 runs in a UNIX environment, there is a capability to switch to an MS DOS environment in which stand-alone software can be executed for Joint Interoperability Tactical Command and Control System (JINTACCS) message processing (using the Navy's JAM-H program), a business support package, and other NDI software.

The MCS program is structured to provide revisions as required and new versions as provided in the block development described in the MCS ROC. These upgrades include:

- Future releases (e.g., V10.3, V10.4) that address user concerns and suggestions for incremental improvement
- Version 11, planned for FY93, that will greatly extend the capability to manage information provided from all functional areas [initial force-level control capability (IFLCC)] using a swivel-chair type interface with other tactical data systems
- Version 12, planned for FY95, that fully automates cross-functional information exchange [force level control capability (FLCC)] and extends joint and combined interoperability.

Maneuver Control Assessment
STATUS OF ARMY'S MCS

- V10 HAS BEEN FIELDED ON TCTs AND TCPs (TO CORPS, DIVISION, AND BRIGADE)
  - Supports:
    - Message processing and message file management
    - Standing requests for information
    - Commander's report on status based on rollup of resource data
    - Display of locally developed graphics as well as charts and vugraphs
    - Database consisting of five files with data dictionary
    - File management, including update from messages
    - Stand-alone NDI software: JINTACCS MTF support (JAM-H), business package
  - Will address suggestions from the units with fielded systems in future releases

- VERSION 11 (V11) WILL BE A MAJOR REDESIGN, AUGMENTED WITH AN INITIAL FORCE-LEVEL CONTROL CAPABILITY AND PORTED TO ATCCS CHS (I0C FY93)

- VERSION 12 (V12) WILL BE FIRST VERSION TO SUPPORT FULLY AUTOMATED CROSS-FUNCTIONAL INFORMATION EXCHANGE (I0C FY95)

RPW 11-26-89-10

Version 10.2 is now being fielded. The initial operating capability was achieved in III Corps, and the 1st Calvary Division conducted some demonstrations in conjunction with scheduled command post exercises (CPXs). The After Action Review of the exercise conducted in August 1989 identified a number of areas where improvements were suggested to improve the usability of MCS.

The chart identifies some of the suggestions from the 1st Calvary Division associated with functionality and design and do not include issues specifically regarding the TCPs and TCTs that will be replaced when the MCS software is ported to ATCCS CHS in Version 11. The performance issues arise because users have encountered situations, such as when the TCP is executing a communications task or a standing request for information (SRI), in which operation of the Analyst Consoles (workstations attached to the TCP) are interrupted for long periods. In addition, there are design and programming features in MCS V10.2 that cause the workstations or the LAN that joins workstations with the TCP to fail. This failure causes some loss of data and significant loss of availability (10-20 minutes to reconfigure a workstation and 20-80 minutes to reload the software for reconfiguring the LAN). Other timing concerns are associated with keystroke response time (one second per keystroke was observed in testing) and interruptions due to database (file) replication.

Users have suggested the human-machine interface be improved to reduced complexity and reduce the training requirements, to provide ruggedized large-screen displays, improve support for preparing system initialization data, and reduce limits on certain parameters in order to be able to handle many types of division configurations.

Many of these areas will be addressed in the next release of MCS software (V10.3) scheduled for early to middle 1990. Some of the areas, however, will require substantial changes to the design and may be deferred to another block of software (e.g., V11). Such areas are: improved processing (in which a TCP is processing communications or SRIs), database replication [in which large files are transferred between command posts (CPs)], keystroke response, and reload times for equipment that is taken off and then put back on line.

Maneuver Control Assessment

SUGGESTED IMPROVEMENTS[7] TO MCS V10.2

- SIMPLIFY HUMAN-COMPUTER INTERFACE TO REDUCE TRAINING REQUIREMENT
- ENSURE ANALYST CONSOLES CAN CONTINUE OPERATIONS WHEN MAIN PROCESSOR IS IN A COMMUNICATIONS MODE OR A STANDARD REQUEST FOR INFORMATION (SRI) IS ACTIVATED
- PROVIDE AUTOMATED ASSISTANCE FOR DEVELOPING SYSTEM INITIALIZATION DATA
- PROVIDE LARGE-SCREEN DISPLAY OR PROJECTOR THAT WILL WORK IN A TACTICAL ENVIRONMENT
- PROVIDE SIMPLE MECHANISM FOR MODIFYING AND REVIEWING TASK ORGANIZATION
- REDUCE TIME REQUIRED TO COMPLETE DATABASE REPLICATION
- IMPROVE KEYSTROKE RESPONSE TIME SO THAT CURSOR KEEPS UP WITH TRAINED OPERATORS AND PROFICIENT TYPISTS
- EXPAND MAXIMUM NUMBER OF NODAL ADDRESSES AND SUBUNITS TRACKED FOR RESOURCE STATUS ROLLUP TO AT LEAST A FULL DIVISION REQUIREMENT
- ENSURE ALERTS ARE PROVIDED IF MESSAGE TRANSFER FAILS
- REDUCE TIME REQUIRED TO BRING FAILED TERMINALS AND LANs BACK ON LINE

NOTE: PM OPTADS HAS DEVELOPED SPECIFICATIONS AND INITIATED SOFTWARE MODIFICATIONS TO ENSURE THESE SUGGESTIONS ARE ADDRESSED IN SUBSEQUENT RELEASES OF MCS

RPW 11-22-989-1

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7 Derived from *After Action Review*, Preliminary Draft, 1st Cavalry Division, September 1989.

The chart evaluates the ability of various versions of the Army's MCS and current Fleet Marine Force (FMF) Initiatives to meet the driving requirements identified by the IDA study team for maneuver command and control. The nine driving requirements are shown with the two levels of priority identified in the previous chart.

The current version (V10.2) of MCS supports Requirements 1, 3, and 4, and the next release in 1990 (V10.3) will support Requirements 2 and 5. However, the database in MCS V10 is a group of files not fully integrated and not managed by a database management system--the integrated database is planned for MCS V11. TCTs and TCPs are very heavy (the TCP weighs 844 lb). Easily transported equipment (Requirement 6) will not be provided until MCS Version 11 is ported to the ATCCS CHS in 1993 (however, ATCCS CHS workstations with printer and modems will weigh 250 lb or more). The MCS program has specific plans to implement the three Priority 2 requirements in later versions of MCS (V12 to be fielded in FY95 and V13 to be fielded in FY97).

FMF Initiatives already support three of the requirements (1, 3, and 6), but without a major change in development plans do not appear to be capable of supporting the common-user database with automatic update from exchanged information, to provide roll-up and other types of resource summaries directly from a database, nor to provide database continuity when portions of command posts are relocated. Of the Priority 2 requirements, only the last is explicitly called out as a preplanned product improvement (P3I).

Maneuver Control Assessment

ASSESSMENT OF SYSTEM OPTIONS FOR PROVIDING ADP SUPPORT TO MANEUVER CONTROL

POTENTIAL DRIVING REQUIREMENT	ASSESSED PRIORITY	PROVIDED BY: MCS	PROVIDED BY: FMF INIT	REQUIRED FOR
1. MANAGES, DISPLAYS, PRINTS INFORMATION	1	V10	Yes	TCO, FIREMAN
2. PROVIDES DATABASE W/ AUTO UPDATE	1	V10	No	TCO, FIREMAN
3. USES EXISTING AND PLANNED COMM	1	V10	Yes	TCO, FIREMAN
4. PROVIDES RESOURCE ROLL UP REPORTS	1	V10	No	TCO, FIREMAN
5. SUPPORTS CONOPS	1	V10	No	TCO, FIREMAN
6. PROVIDES EASILY TRANSPORTED EQUIPMENT	1	V11-CHS	Yes	TCO, FIREMAN
7. SUPPORTS AUTO CROSS-FUNC INFO EXCH	2	V12	No	TCO
8. SUPPORTS JOINT INTEROPERABILITY	2	V12	No	TCO, FIREMAN
9. INTEGRATES AVAILABLE PLI	2	V13	P3I	TCO, FIREMAN

Notes: a. MCS V10.2 has been fielded on TCTs and TCPs.
b. MCS V10.3 is being developed for fielding on TCTs/TCPs in 1990.
c. MCS V11 is being developed for fielding on CHS as well as TCTs/TCPs in 1993.
d. MCS V12 is planned for FY95, and MCS V13 is planned for FY97.

RPW-12-18-89-10

The issues identified on this chart require ongoing efforts from both Services to refine and develop detail for maneuver control requirements during the next few years. Specifically, the Services need to carefully define and prioritize the detailed functions to be performed by ADP systems in support of maneuver control C2. Both Services have general requirements for planning, evaluation, and support for decisionmaking, but there is not yet sufficient detail to begin to include these in any significant way into the system specifications or to evaluate the cost-benefit tradeoff prior to making implementation decisions.

Both Services have indicated that they plan to select and modify where necessary NDI equipment and installation kits to meet operational environmental and usability requirements. The degree of ruggedization needed may vary among the echelons and CPs, depending on the vehicles and shelters that are available and the range of intended missions. Similarly, the size and weight limits on the equipment configurations may need to be tailored to echelon or type of CP. Thus, imposing a single weight limit (e.g., 30 lb) for a module, regardless of configuration, may needlessly eliminate some emerging technology options.

The single most important driver in the degree of complexity of the ADP support system for C2 and the association communications support required is the specification of IERs. Of particular importance to maneuver control and the force level control capability is the specification of cross-functional and other types of force-level exchange requirements. Limiting this type of information flow (such as to support the Commander's database) could have a dramatic impact on the system complexity, responsiveness, and need for data communications. Further, a well-developed information model based on these IERs could lead to more efficient database designs, to include such features as partitioning, partial replication, and a mix of push- and pull-type triggers for information flow.

Exploring the potential of the Army's MCS to meet the full range of Marine Requirements needs to address both Service's information models, data management, communications load analysis, and forms of data presentation to support decisionmaking. Some of these requirements could be addressed by developing objectives for an early operational assessment of MCS. In addition, some testbed experience (such as at the I MEF Testbed) with a partial porting of V10 software to ATCCS CHS could support both the users and the developers. One area to be addressed would be the integration of existing FMF initiatives into an evolving objective capability (e.g., addressing the need for file transfer).

Both Services need to continue assessing the requirements for data communications to support the evolving ATCCS and MTACCS concepts.

Maneuver Control Assessment
REQUIREMENT AND PROGRAM ISSUES

- WHAT SPECIFIC FUNCTIONS SHOULD BE AUTOMATED TO SUPPORT PLANNING, EVALUATION, AND DECISION MAKING?
- WHAT DEGREE OF RUGGEDIZATION IS REQUIRED AND HOW SHOULD NDI BE TESTED?
- WHAT SHOULD BE THE SIZE AND WEIGHT LIMITS FOR THE OPERATIONAL FACILITY CONFIGURATIONS AND WORKSTATIONS?
- WHAT ARE THE SPECIFIC INFORMATION EXCHANGE REQUIREMENTS FOR CROSS-FUNCTIONAL AND OTHER TYPES OF FORCE-LEVEL INFORMATION FLOW?
- WHAT INFORMATION IS REALLY REQUIRED IN THE COMMANDER'S DATABASE, WHAT FRACTION OF IT SHOULD BE REPLICATED AND AUTOMATICALLY UPDATED?
- WHAT SHOULD BE THE OBJECTIVES OF AN EARLY OPERATIONAL ASSESSMENT OR CONCEPT EVALUATION OF THE ARMY'S MCS?
- IS AN FMF TESTBED REQUIRED TO GAIN EXPERIENCE WITH MCS AND THE ASSOCIATED DIGITAL COMMUNICATIONS OR TO REFINE REQUIREMENTS BEFORE MAKING A PROCUREMENT DECISION?
- WHAT ADP SUPPORT AND INTERFACES ARE REQUIRED TO ENSURE AN OBJECTIVE SYSTEM CAN INTEROPERATE, WHERE REQUIRED, WITH CAPABILITIES CURRENTLY FIELDED IN THE FMF (e.g., FILE TRANSFER)?
- WHAT COMMUNICATIONS ARE REALLY REQUIRED TO FULLY SUPPORT MTACCS AND ATCCS?

RPW 11-26-89-12

The chart identifies a wide range of options that could be considered by the Marine Corps to be included in an evolutionary development program. Most of these options are already being discussed in the FMF and at MCRDAC, and some are being actively explored.

Expanding FMF initiatives and standardizing the capabilities within and among the MEFs would improve near-term support and lead to better understanding of information exchange and other requirements for an objective system. Prototype testbeds have been used in the past and are being expanded to evaluate some technology options.

Migration of the standards to nonproprietary choices [e.g., the LAN and operating system interface, such as the Portable Operating System Interface for Computer Environments (POSIX)] would increase the potential to use NDI hardware and software and reduce hardware dependencies of developed software.

Although the ATCCS CHS does not meet the 30-lb goal for hardware components, this hardware provides a significant improvement in throughput over the FMF EUCE and appears to be sufficiently rugged for many types of CPs. Further, adopting ATCCS CHS, at least initially, would allow the Marines to continue to exploit the developments in ADP support of C2 in all functional areas.

There is a wide range of activities that could be considered for participating in development of MCS, including both V11 (already underway) and V12. A multi-Service MCS could be the result of these activities, similar to the multi-Service program now underway for AFATDS.

Maneuver Control Assessment

OPTIONS BEING CONSIDERED FOR EVOLUTIONARY DEVELOPMENT OF ADP SUPPORT FOR USMC MANEUVER CONTROL

- **EXPANDING FMF CAPABILITY AND REFINE REQUIREMENTS:**
  - Standardize FMF initiatives within and among the MEFs
  - Expand FMF initiatives (e.g., integrated database, graphics, PLRS/PC interface)
  - Develop prototype/testbed that explores potential of new technologies
  - Specify detailed requirements for force-level control
  - Evaluate NDI alternatives for ADP support of tactical C2
- **ADOPTING NON-PROPRIETARY STANDARDS:**
  - Migrate to UNIX/POSIX-based operating system environment
  - Transition to international non-proprietary standards for data communications (e.g., ISO 8802.3 LAN)
- **EXPLOITING OPPORTUNITIES WITH THE ARMY:**
  - Use, where possible, ATCCS CHS
  - Participate with Army in developing specifications for next generation CHS
  - Evaluate Army's MCS (e.g., V10, V11, V12)
  - Participate in multi-Service program for maneuver and force-level control system(s)

RPW 11-26-89-11

The IDA study team has identified a wide range of requirements in the area of ADP support for maneuver control C2 that are common to both the Army and the Marine Corps. At a fundamental level the Services have essentially the same basic requirements.

The FMF initiatives constitute a significant capability for support of maneuver control C2, but they do not meet many of what appear to be driving requirements and therefore do not appear to be satisfactory as a foundation for an objective system. MCS, on the other hand, appears to a viable system option for both the FIREMAN (whose ROC is imminent) and TCO (whose ROC will probably need to be revised to reflect the changes in system concepts that have evolved since 1978).

As indicated on the previous chart, there are still a number of requirements-oriented issues that need to be resolved before a comprehensive R&D strategy can be defined and a decision made for moving toward an objective system. However, given the high degree of commonality in the requirements, it would appear that the Marine Corps should seriously consider options that include participating in MCS. Early participation could lead to identifying ways to make V11 significantly more effective for the Marine Corps. Goals that could be achieved are:

- Working to achieve a common or compatible information model that includes the requirements of both Services. This could lead to common data management mechanisms; common, compatible, or translatable data elements; and common or compatible database design characteristics (e.g., partitioning and partially replicating).
- Using the same hardware, at least initially, with some differences in configurations; ATCCS CHS would be strongly preferred over the TCTs and TCPs (TCPs weigh 844 lb, whereas CHS workstations range from 250 to 450 lb).
- Focusing primarily on V11 and eventually on V12 (V11 does not meet all the driving requirements).
- Develop a Commander's database design that would meet the minimum requirements of both Services (the contents of the databases could be different for the Services, depending on initialization data).
- Working together on procuring as NDI a lightweight workstation, such as a laptop computer.
- Accelerating the implementation of support and (eventually) automated interfaces for PLI (e.g., interfaces to PLRS/EPLRS master station, interface directly between personal computers and PLRS, as has been demonstrated by the Marine Corps).
- Working together on cross-functional user interface requirements, Joint interoperability, and interoperability with the Allies.

Maneuver Control Assessment
CONCLUSIONS

- BOTH SERVICES HAVE ESSENTIALLY THE SAME BASIC REQUIREMENTS
- FMF INITIATIVES ADDRESS SOME BUT NOT ALL DRIVING REQUIREMENTS AND ARE NOT CONSIDERED SATISFACTORY AS FOUNDATION FOR BUILDING AN OBJECTIVE SYSTEM
- MCS, WITH MODIFICATIONS, APPEARS TO BE A VIABLE SYSTEM OPTION FOR FIREMAN AND, EVENTUALLY, TCO
- MARINE CORPS NEEDS TO RESOLVE A NUMBER OF REQUIREMENTS ISSUES BEFORE A COMPREHENSIVE R&D STRATEGY CAN BE DEFINED
- ACTIVE PARTICIPATION IN THE ARMY'S R&D PROGRAM FOR MCS COULD BE BASED ON ACHIEVING SUCH GOALS AS:
  - Both Services working to field the same system with different database content (determined at system initialization) and configurations
  - Initial fielding for Marine Corps based on ATCCS CHS and Version 11 software
  - Modifying design of Commander's Database, if necessary, to meet the requirements of both Services
  - Procuring lightweight workstation (e.g., laptop computer) as NDI and fielding by Services in highly mobile units
  - Developing an automated interface to the PLI in PLRS/EPLRS
  - The Services working together to address automated cross-functional, Joint, and Combined interoperability requirements

RPW 11-26-89-13

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3. FIRE SUPPORT ASSESSMENT

The fire support assessment begins with background for fire support that identifies previous IDA studies in this area and the status of Marine Corps initiatives for FIREFLEX. This background is followed by a summary of the status of AFATDS (now a multi-Service program) and identification of issues associated with the Marine Corps' plans to field AFATDS. The section concludes with a summary assessment and conclusions.

FIRE SUPPORT ASSESSMENT

- BACKGROUND
- STATUS OF AFATDS--MULTI-SERVICE PROGRAM
- FIELDING AFATDS TO MARINE CORPS
- ASSESSMENT
- CONCLUSIONS

RPW-12/15/89/3

In November 1986, IDA conducted a study of Service plans to develop two fire support C2 systems: MIFASS and AFATDS. The study concluded that MIFASS would not provide the Army a significant improvement over the Tactical Fire Direction System (TACFIRE) and that fielding MIFASS to the Army would cost four times as much as AFATDS and would weigh 2 to 5 times as much. It also concluded that AFATDS could be adapted to meet the Marine Corps' needs, that adaptability needed to be demonstrated, and that fielding AFATDS to the Marine Corps would reduce the system cost and weight significantly. Substantial schedule risks were identified for AFATDS (the IOC has since slipped from FY91 to FY94 for heavy divisions). IDA recommended that:

- DoD and the Army should support continuing the AFATDS program
- MIFASS Operational Test II (OT II) be completed and the Engineering Development Model (EDM) equipment be put in an operational unit
- Marine Corps test the adaptability of AFATDS to meet its needs
- Marine Corps provide a detailed development and fielding plan for their system based on the results of the Adaptability Evaluation Program and the MIFASS OT II.

In November 1988, IDA conducted a study of Marine Corps fire support requirements and potential system options and concluded that, if modified, the FIST DMD, LTACFIRE, and AFATDS could meet, at least partially, FIREFLEX requirements; that an operational assessment of the AFATDS concept could be conducted by the Marine Corps in late FY89 or early FY90; and that, if not otherwise directed, the Army and the Marine Corps may implement incompatible data communications protocols for bit-oriented message (BOM) standards. IDA recommended that OSD request the Marine Corps to conduct an AFATDS assessment, building on the Concept Evaluation, and assist in providing adequate resources; task JTC3A to determine which communications protocol would be operationally best suited for BOM; and request the Joint Staff to review/validate requirements for a Joint BOM protocol and take steps necessary to meet future BOM interoperability requirements.

The Marine Corps has a validated ROC for FIREFLEX (approved April 1989) and has structured the R&D program for FIREFLEX based mainly on participating in AFATDS. A Memorandum of Agreement (MOA) was signed by two Service PEOs (MGen Kind and MGen Franklin) in June 1989 to identify Service initiatives to make the program for AFATDS a multi-Service program. MCRDAC is providing on-site representation (not yet full time) for OPM FATDS at Fort Monmouth, has provided $2.0 M in FY89 to initiate a task order to support Marine Corps objectives, and is planning an FMF demonstration of AFATDS in February 1990. OSD has supported the two Service's initiatives to obtain additional FY89 and FY90 funds ($2.0 M each year) to participate in AFATDS; however, the agreements required to release the FY90 funds already identified are not yet complete.

The Marine Corps expects to continue the user involvement begun in 1989 by expanding the fire support testbed to all three MEFs for training, exercise, and demonstration. Equipment includes the BCS, MDS, AN/TPQ-36 FIREFINDER, PLRS, and DCT. Formal appraisals of concepts for modified LTACFIRE and modified FIST DMD were conducted in the second quarter of FY89. The Marines are using both Marine and Army protocols for the DCT, the former for Marine Corps interoperability and the latter for interoperability with the TACFIRE-based systems (BCS, MDS, and FIREFINDER). Army CHS will be added to the testbed, together with prototype software for fire support (and other functional areas) whenever the software becomes available.

Fire Support Assessment
BACKGROUND FOR FIRE SUPPORT

- **IDA PREVIOUSLY ASSESSED FIRE SUPPORT REQUIREMENTS/OPTIONS**
  - Evaluated MIFASS versus AFATDS for both Services
  - Compared Marine Corps fire support requirements with Army system options
- **MARINE CORPS VALIDATED ROC (FIREFLEX)**
- **MARINE CORPS HAS R&D PROGRAM BASED MAINLY ON PARTICIPATION IN AFATDS**
  - MOA signed by PEOs
  - On-site representation with OPM FATDS at Fort Monmouth (intermittent)
  - Task Order funded by both Services for multi-Service AFATDS program
  - OSD supported Service efforts to obtain additional funds ($2M FY89, $2M FY90) for Marine Corps participation
  - Next milestone is FMF demonstration of AFATDS in Feb 1990
- **FIREFLEX TESTBED WILL CONTINUE ACTIVE FMF INVOLVEMENT IN ADP C2 SUPPORT FOR FIRE SUPPORT**
  - Appraisals for modified LTACFIRE and modified FIST DMD completed
  - Each MEF has R&D assets to support user involvement
  - Equipment supports training, exercise, and demonstrations
  - Fielded systems: BCS, MDS, TPQ-36, PLRS, DCT (Marine Corps software)
  - R&D assets are based on those being fielded to Army Light Divisions: LTACFIRE (modified), FIST DMD (modified), DCT (with Army software)
  - Army CHS to be added

RPW 11-26-89-2

Concept Evaluation (CE) for AFATDS was conducted from March to April 1989 by the Test and Experimentation Command Field Artillery Board (TEXCOM FABD) at Fort Sill. An Independent Operational Assessment, a Cost and Operational Effectiveness Assessment (COEA), and a Test and Evaluation Master Plan (TEMP) were all completed in July 1989. This testing and evaluation noted that the CE system had a very low error rate (no Priority 1 or 2 errors and less than 15 percent of the allowed number of lower priority errors) and identified the need to improve status information in fire support execution, time required for fire support planning, and reinitialization for the LAN (for continuity of operations).

On 19 July 1989, the Army Systems Acquisition Review Council (ASARC) made a Milestone II decision to proceed with full scale development (FSD). This decision was ratified by the OSD Conventional Systems Committee and the Defense Acquisition Board (DAB) in August and September, respectively. The main OSD issue was the acceptability of the proposed maintenance concept, and the Army has stated that this is under reconsideration. Documentation provided to OSD in August 1989 included a Baseline Cost Estimate (BCE) and a draft AFATDS Program Baseline. The final Program Baseline was approved by the Army on 2 October 1989 and by OSD on 11 October 1989, at which time the Defense Acquisition Executive authorized the Army to proceed with FSD. This authorization also stated that at Milestone III, OSD will "review AFATDS for adequate Marine Corps functional integration."

IOC for AFATDS is now planned for March 1994, allowing approximately 4 years to port the CE software to the ATCCS CHS, complete the systems engineering, and develop the new software required for comparability to TACFIRE capabilities. The system specification for Version 1 is complete and is now undergoing review to specify items previously left to be determined. Standard Integrated Command Post System (SICPS) shelters will be used. The FSD contract is expected to be negotiated with the CE contractor (Magnavox Electronic Systems) early in 1990.

Since the Army plans to use only about half of the CE software in Version 1 AFATDS, much of the CE software may not be ported to the CHS--this could mean that there may be little or no operationally useful software (based on fire support functions developed for CE) that could be demonstrated on the CHS until the later stages of FSD. A more complete and earlier opportunity for a demonstration on CHS was the goal of earlier, informal FSD plans, and would be helpful to both Services.

AFATDS is now a multi-Service program that could lead to a system that could be fielded to both the Army and the Marine Corps. It is possible that the IOC software could be identical for the Services, with differences in the implementation of the database and the initialization data that would invoke specific features and activate modules of software for the nodes at system initialization. Software used by only one Service could be left inactive and invisible to users of the other Service. The two Services have agreed in the MOA to implement Joint interoperability in Version 1 AFATDS, but details of the protocol to be used with the agreed-to messages are still not settled.

Fire Support Assessment

STATUS OF AFATDS

- **AFATDS CONCEPT EVALUATION SATISFACTORILY COMPLETED**
  - Fort Sill identified some areas for improvement
  - Very few software problems
  - OTEA strongly supported AFATDS at ASARC
- **AFATDS COMPLETED ASARC AND DAB MILESTONES**
  - Baseline defined
  - Basic Cost Estimate (BCE) completed
  - Cost and Operational Effectiveness Analysis (COEA) accepted
  - Only DAB issue was maintenance concept (Army is conducting further studies)
- **IOC IS PLANNED FOR MAR 1994 (FUE IS FEB 1993)**
  - Will use ATCCS CHS, including standard SICPS shelters
  - Requires porting to CHS, systems engineering, and software development for adding new functions
  - Version I specification is complete
  - Contract being negotiated with Magnavox
  - Early systems engineering for Marine Corps requirements has begun
- **NOW A MULTI-SERVICE PROGRAM**
  - Potential to field a single system to both Services
  - IOC software could be identical (Service-unique features defined by data and invoked at system initialization)
  - Hardware components could be identical, with different configurations for two Services
  - Details of Joint protocols still not settled

RPW 11-26-89-3

The Services could use identical hardware components and field the configurations required by each Service. If there are Service-unique configurations, then there might be Service-unique installation kits. The Marine Corps could field the AFATDS software on Marine-unique hardware (if required, for example, by more severe ruggedization requirements), but this could lead to significant investment and to systems problems that would make it more difficult for the Marine Corps to exploit the CASS and applications software developed by the Army for Version 2 AFATDS.

Configurations of AFATDS workstations for the Marine Corps are still being studied. One proposal being evaluated is a set of three configurations with two, three, and four terminals, respectively. The four-terminal configuration would be used at Division Fire Support Coordination Center (FSCC), MAGTF Headquarters Supporting Arms Special Staff (SASS), TACC, and Supporting Arms Coordination Center (SACC, afloat). Three-terminal configurations would be used at Regiment FSCC, Regiment Fire Direction Center (FDC), Battalion FSCC, Battalion FDC, and the ANGLICO Supporting Arms Liaison Team (SALT). The Direct Air Support Center (DASC) and other units would get two-terminal configurations. An early plan for these workstations was to use a mix of color and monochrome SDUs with TCUs for the workstations (and no PCUs). In this example, each workstation would have a printer, and each configuration would have two APIUs, an HDU with a 100-Mbyte cartridge, and an archive device (e.g., magnetic tape unit). There would be no medium- or large-screen display, but each operator would have a 12- or 16-in display.

PM MAGTF C2 is planning a series of exercises and demonstrations beginning in 1990 to explore the potential of various configurations of ATCCS CHS to meet the Marine Corps requirements. Other technologies and degrees of ruggedization will also be evaluated to define options available from NDI equipment. Testing of ATCCS CHS with software having some operational utility needs to be performed during the next two years. The Marine Corps may need to develop options to further ruggedize components of the ATCCS CHS (i.e., to provide additional protection against moisture and extremes of operating and transport temperatures).

Initial estimates of the cost[8] of procuring workstation configurations for the Marine Corps in fielding AFATDS ranged from $100,000 for a two-terminal configuration to $160,000 for a four-terminal configuration. The total for 163 of the configurations (402 terminals) to fully field AFATDS would be about $21 million, not including the cost of spares (about $13 million, based on a spare of each component for each configuration) and maintenance (about 1.5 percent of the procurement cost per year). Approximately 400 shelters are planned, at a cost of $50,000 each. The procurement would cost $34 million for hardware and $20 million for shelters, for a total of $54 million.

The Army's BCE identifies the average recurring unit cost of a V2 (most rugged equipment) Fire Support Computer Terminal (FSCT, based on the TCU) as $50,800 (591 at $30.0 million). Each of these workstations includes a 100-Mbyte disk, an APIU, and an archive device. The FSCT has a color SDU. The cost bases used by the Services for the equipment components is approximately the same. However, the Army's BCE shows that a substantial part of the production cost is a system cost not allocated to equipment items. For example, the recurring portion system cost for AFATDS not allocated to any of the major component items is estimated in the BCE at $117.7 million. This is about 20 percent of the total recurring portion ($582.3 million, not including cost of the shelters) of the production cost. Similarly, the Army estimates the average unit hardware cost of a High Mobility Multi-Wheeled Vehicle (HMMWV) SICPS shelter at about $44,000, but the acquisition (flyaway) cost at about $83,000. It is not clear if the Marine Corps has included these system-level costs in their procurement estimates.

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8 All cost estimates are in constant FY90 dollars.

Fire Support Assessment

FIELDING AFATDS TO MARINE CORPS

- CONFIGURATIONS OF EQUIPMENT ARE STILL BEING EVALUATED
  - -- ATCCS CHS is being considered
  - -- Configurations of CHS may differ from Army
- SEVERAL STANDARD WORKSTATION CONFIGURATIONS HAVE BEEN PROPOSED
- ANALYSIS IS STILL NEEDED TO DETERMINE IF RUGGEDIZATION OF ATCCS CHS IS ADEQUATE
  - -- Testing needs to be done
  - -- Marine Corps configurations may need unique modifications (e.g., installation kits with greater protection from moisture and temperature)
- EARLY COST ESTIMATES APPEAR TO BE LOW
  - -- Marines estimated workstation costs based on major components
  - -- Cost of workstation could be greater when integration costs not attributable to single items are included

RPW 11-26-89-4

By participating in AFATDS as early as FY89, the Marine Corps can obtain a version of AFATDS that can meet their requirements for an objective system at a low additional investment. The Army and the Marine Corps are seeking to add to the current AFATDS specification provisions to ensure that the Version 1 system will be operationally suitable for both Services. For the Marine Corps, this means extending the human-machine interface and possibly the database to support doctrine, task organization, and other special characteristics. Most of the special characteristics are hoped to be achieved by varying the data used by the Services at initialization. In addition, the Marine Corps and the Army have agreed to add the Marine Tactical System (MTS) fire support messages and protocols (both broadcast and switched) in Version 1 to support interoperability with the fielded DCT and other MTACCS systems. Finally, the Services have reached agreement on the data element dictionary, messages, and message syntax for Joint interoperability between fielded AFATDS systems of the two Services.

Work still needs to be done to reach agreement on the protocols to be used to transmit the agreed-to fire support messages for Joint interoperability. JTC3A has recommended to OSD that the MTS protocols be used for this purpose. The Army is seeking to expand the services provided by the protocols (otherwise these services, such as relay, would have to continue to be handled by the application software in AFATDS). Even if no additional services are agreed to for Version 1 AFATDS, it appears that some modification of the MTS protocols would be needed to support all the features of the agreed-to message syntax (alternatively, the message syntax could be modified, but the result would be significantly less useful in Service applications for other than this specific interface).

Further, the Services need to begin soon to develop the detailed specifications for the ADP support to be provided in Version 2 of AFATDS, specifically for functions such as support of naval gunfire (NGF) and close air support (CAS). Version 1 AFATDS will provide weapons effectiveness tables for naval guns and will identify targets for which CAS is the preferred fire support means, but these areas need to be significantly expanded. However, the detailed requirements have not yet been developed by the users of either Service.

As indicated in the system concept assessment, common application support software (CASS) is a major goal of both Services. The Army has a working group in place and ambitious goals to achieve a major portion of CASS during the next few years so that CASS can be implemented in AFATDS and FAAD C2I at their IOC and by MCS Version 11 on the CHS. Initial Operational Test and Evaluation (IOT&E) of these systems is planned for FY93. However, neither of the contracts in place for FAAD C2I and MCS nor the AFATDS FSD contract being prepared appears to make explicit provisions for development of CASS.

CASS is an initiative that could have major benefits to both Services in achieving stated objectives and lowering the long-term developmental, procurement, and maintenance costs of currently planned tactical data systems. However, if the Services want to maintain the schedules contained in the program baselines for AFATDS, FAAD C2I, and MCS, the scope and management of CASS development needs to be carefully controlled. Without effective management, the drive to develop as much CASS as possible will lead to increased schedule risk for all three systems, but specifically for AFATDS. Key management practices would include limiting the scope of CASS modules; specifying the functionality, design, interfaces, and technical features early; obtaining agreement and support among the PMs for specific initiatives; developing and maintaining realistic schedules; getting documentation, specifically for the software interfaces, under configuration control early in the development; and providing adequate resources of expert personnel, time, technical support, and equipment for configuration management and conformance testing.

Fire Support Assessment

ASSESSMENT

- **EARLY MARINE CORPS PARTICIPATION IN AFATDS WILL LEAD TO AN OBJECTIVE FIREFLEX SYSTEM AT LOW ADDITIONAL INVESTMENT**
  - Human-machine interface that supports doctrine, task organization, and special characteristics of each Service
  - Joint automated interface that addresses the full set of agreed-to IERs between the two Services
  - Interoperability with USMC forward entry device: DCT
- **WORK STILL NEEDS TO BE DONE**
  - To complete the Joint interface specification, making the selected protocols match the agreed K-series message syntax (variable message format)
  - To identify specific ADP support specifications for beginning Block II development at end of 1990 (CAS, NGF)
- **EFFORTS TO CREATE AND IMPLEMENT CASS FOR MCS, FAAD C2I, AND AFATDS SIMULTANEOUSLY COULD CREATE A SCHEDULE RISK FOR AFATDS**
  - Scope of common applications support software (CASS) needs to be limited
  - Specifications need to be tabled and agreed to early
  - Schedules must be realistic
  - Software interface specifications under configuration control are needed early
  - Adequate resources (personnel, time, technical support, equipment) are needed for configuration management and conformance testing

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By moving forward with an MOA and funding a multi-Service program, the Services have agreed that AFATDS can be developed to meet the needs of both Services. The multi-Service program is already underway. The goal of a single version of software for Version 1 appears to be achievable and potentially suitable for both Services. However, substantial work needs to be done by both Services to develop detailed specifications for ADP support of close air support and naval gunfire for the Version 2 software development that is scheduled to begin early in 1991.

The Army and the Marine Corps need to finish their work shortly on specifying the standards to be used for the Joint fire support interface, in order to meet the schedule for AFATDS Version 1. The Army may have to defer some of their priority requirements for additional services in the data communications protocols, and the Marine Corps may need to modify the MTS standard to avoid having two sets of protocols and messages for fire support, if the Joint protocol is to be used by the Services for other than this specific interface. Since the Marine Corps has a significant investment in the current MTS, modifying MTS in all sets of DCT software and the implementations in other MTACCS systems would not be cost effective unless the Joint protocol is to be used more widely than for AFATDS-to-AFATDS exchanges.

The schedule provided by the Army for the AFATDS program baseline now provides sufficient time to complete the porting, system engineering activities, and new software development without high schedule risk. However, the IOC for AFATDS for heavy Army divisions has slipped 3 years (from FY91 to FY94) during the last 3 years (November 1986 to December 1989). Further slips could jeopardize the program, and schedule risks must therefore be kept very low. Specifically, the CASS initiatives need to be carefully managed to avoid creating a new schedule risk for AFATDS.

As soon as the plans are approved, the Marine Corps needs to provide details of their funding profiles and procurement strategy to support fielding of AFATDS. These plans should show the support for short- and long-term participation in the multi-Service development and testing program, as well as the funding required to complete procurement. Unless there are substantiated unmet requirements for ruggedization or lower-cost options, the acquisition of the IOC version of FIREFLEX should be based on AFATDS Version 1 and the ATCCS CHS.

Fire Support Assessment

CONCLUSIONS

- AFATDS CAN BE DEVELOPED TO MEET THE NEEDS OF BOTH SERVICES
- WORK ON SPECIFICATIONS FOR CAS AND NGF NEEDS TO BE COMPLETED IN 1990
- SERVICES NEED TO COMPLETE WORK ON JOINT INTERFACE STANDARD VERY SOON TO MEET SCHEDULE FOR VERSION 1
  - -- Army may need to accept protocol that does not contain all the advanced features needed (e.g., auto relay)
  - -- MTS protocol may need modification to match message syntax
- CURRENT SCHEDULE APPEARS SOUND, BUT EFFORTS TO MAXIMIZE ATCCS COMMON APPLICATION SUPPORT SOFTWARE COULD CREATE A RISK
- PLANS FOR MARINE CORPS' ACQUISITION OF AFATDS NEED TO BE COMPLETED AND PROVIDED TO OSD

RPW 11-26-89-6

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4. AIR OPERATIONS ASSESSMENT

The air operations assessment was originally focused in the Task Order on airspace coordination and control. At the midterm briefing to OSD, it was agreed to focus on the concept of a battlefield air picture, one that provides airspace C2 information for use in supporting land warfare functions other than the control and employment of air defense surface-to-air missiles.

The section begins with background that provides the operational context for the increasing challenge in managing airborne force elements and explains the concept of a battlefield air picture. This background is followed by a summary of the status of requirements and an assessment of the potential use and benefit of the battlefield air picture. The section ends with a list of opportunities and the conclusions.

AIR OPERATIONS ASSESSMENT

- SCOPE: FOCUS ON BATTLEFIELD ("MUD") AIR PICTURE
- BACKGROUND
  - -- Operational context
  - -- Concept of battlefield air picture
  - -- Example battlefield air picture
- STATUS OF REQUIREMENTS
- ASSESSMENT: POTENTIAL USE AND BENEFIT
- OPPORTUNITIES
- CONCLUSIONS

RPW-12/15/89/4

A battlefield or "mud" air picture could be a key element to integrated and combined arms operations common to both the Army and Marine Corps. Mobility and maneuver, including over-the-horizon operations, will be major factors in future battles whether against first-line Soviet or Third-World forces. Consequently, the scope of the battlefield and associated areas of influence and interest will be larger.

The future battle will require strenuous efforts to keep the Commander and staff oriented, not just informed, as to friendly and enemy situations. A three-dimensional battlefield picture is needed to take advantage of enemy positional weaknesses and to avoid falling into a reactive (rather than proactive) mode.

Surface and airborne force elements will be faster over future battlefields. For example, the M1A1 tank can dash at speeds comparable to helicopters maneuvering in nap-of-the-earth terrain flight. The LCAC can move in air-cushioned flight at 40 knots, and new technology helicopters capable of both air-to-ground and air-to-air weapon engagements can move upwards of 180 knots. Tilt-rotor air platforms, enemy or friendly, could carry troops and weapons at speeds of 200-300 knots. The fast moving future battlefield will be significantly different from past situations where visual contact was possible or where overall relatively slow movement of enemy or friendly forces could be tracked or predicted.

Management or control of surface-force movements and airspace immediately over the battlefield is today mostly procedural. Fire support coordination and maneuver are based on planned missions and positions and not on real- or near-real-time positional information. An on-call field artillery fire mission within the vicinity of low flying aircraft frequently needs coordination between several activities at different organizational levels. The inherent delay in procedural coordination varies, but that delay results in reduced fire support effectiveness. If an FSE or FSCC were observing a real-time battlefield air picture, there need not be any coordination delay as fire support coordinators would know when fires could be delivered without endangering aircraft, and aircraft crews would know that flight paths would not be subject to friendly fires. Thus, an available real-time air picture could reduce reliance on time-consuming procedural coordination and provide improved orientation on status of forces to support more effective maneuver.

Operations at night and in adverse weather are noted for being difficult and significantly slower in tempo. Degraded visual orientation results in an increased use of procedural controls. With a low-altitude air picture available for night and adverse weather operations control, the tempo could be significantly improved.

Beginning in 1986, Joint doctrine (JCS Pub 26) recognized an active air defense mission for helicopters equipped with self-protection air-to-air weapons. This is due, in part, to the increasing threat from VTOL aircraft such as HIND, HAVOC, and HOCUM. Successful counterair operations are recognized to depend on situation awareness by the aviator, control of the air battle, and effective airspace control.

Technology is available today to support distribution and display of an air picture at lower costs and in smaller configurations than has been possible in the past. Microcomputers are now available with very high throughputs, many digital communications functions are now available on microchips, and screen display technology has improved in resolution, color, and responsiveness.

Air Operations Assessment

BACKGROUND FOR BATTLEFIELD AIR PICTURE-- OPERATIONAL CONTEXT

- **POTENTIALLY A KEY ELEMENT OF COMBINED ARMS OPERATIONS**
- **INCREASING CHALLENGE IN MANAGING (AIRBORNE) FORCE ELEMENTS:**
  - Deeper area of interest to Land Warfare Commander (further beyond FLOT)
  - Inadequate low-altitude radar coverage
  - Use of larger numbers of air-mobile and airborne maneuver forces
  - Maneuver force's mobility, range, and speed reduce time for identifying potential conflicts and completing airspace coordination
  - Exploiting air mobility at night and in degraded weather conditions
  - Low-altitude counterair operations against VTOL threat
- **TECHNOLOGY SUPPORTS LOWER COST AND SMALLER CONFIGURATIONS FOR INTEGRATION AND DISPLAY**

RPW 11-26-89-7

The concept of a battlefield or "mud" air picture is tied to increasing requirements for battlefield C^2 in the third dimension. The current two-dimensional view of a battlefield, with an associated heavy focus on surface force movement, is based on non-real-time and not very precise voice manual positional inputs. This planar view does not accurately portray or provide a proper orientation as to what will be occurring in fast moving deep battle and maneuver warfare, including low and medium altitude air operations. What is needed is a battlefield picture that provides multi-functional airspace information and improved battlefield orientation for the land warfare commander.

A battlefield or mud air picture is defined as a correlated display of identified aircraft positional information overlaying battlefield graphics and appropriate unit locations as available. A mud air picture as envisioned would consist of the following features:

- Inputs from multiple sensors that have been correlated and identified as air track information
- Other positional inputs, to include voice-manual (e.g., from GPS) or electronic (e.g., from PLRS) information
- Battlefield graphics to show unit boundaries and locations, where appropriate, and fire support and airspace control coordination measures.

In as much as a mud air picture would be, in large part, dependent upon the availability of sensor inputs, it is assumed that sensors may not always be available. Therefore, a descriptive air picture may be the only type of air picture that could be generated. To this end, textual data relative to mission status, proposed air space use, timing, and whatever sensor data or positional reports were available would be provided as an option.

A mud air picture should also be able to filter aircraft tracks, change scale and declutter features in order to minimize, where possible, information exchange requirements and avoid saturating the display.

Finally, the availability of an air picture will be largely governed by sensor coverage. Use of ground-based sensors, if available in sufficient numbers to provide adequate low- and medium-altitude coverage, could be acceptable. However, difficult terrain situations may mask or restrict sensor employment. Further, fast moving tactical situations may not permit timely employment of ground-based sensors. In amphibious operations, ground-based sensors may not be deployable in the first days of an amphibious assault. Consequently, the capability to access air platforms or have air platforms included in organic maneuver force structure would be helpful in establishing an effective air picture.

Air Operations Assessment

CONCEPT OF BATTLEFIELD AIR PICTURE

- **DISPLAY OF CORRELATED AIRCRAFT POSITIONAL AND IDENTIFICATION INFORMATION TOGETHER WITH BATTLEFIELD GRAPHICS**
  - Correlation permits acceptance of identified (friendly, hostile, unknown) multi-sensor aircraft track information
  - Position information includes electronic and manual inputs
  - Battlefield graphics include unit boundaries, coordination measures, and unit locations, where appropriate
- **OPTION: MISSION DATA FOR FRIENDLY AIRCRAFT**
- **FUNCTIONS: CHANGE SCALE, FILTER AIRCRAFT TRACKS, AND SELECT FEATURES TO DECLUTTER DISPLAY AND AVOID SATURATION**
- **KEY: AVAILABILITY AND ACCESS TO SENSOR INFORMATION FROM AIR PLATFORMS AS WELL AS GROUND-BASED SENSORS**

RPW 11-22-89-24a

The example battlefield air picture shown in the chart illustrates the use of correlated air tracks, battlefield graphics, and friendly aircraft mission and unit text. Crossing the corps-level display are two low-level transit routes (LLTRs), denoted by parallel dashed lines. Air tracks (at the right) are denoted by symbols with a vector showing approximate speed (length of vector) and direction. Different symbols are used to distinguish unknowns and hostile tracks from friendly tracks. Hostile aircraft are shown with diamonds, friendly aircraft with circles, and unknown aircraft with a "U." Track numbers may be displayed or suppressed--in the upper right portion of the figure, Track 1508 is an unknown, Track 1203 is friendly, and Track 1180 has been designated as hostile. Track 0381 is a friendly airborne sensor.

Orientation for the ground situation is denoted by the unit boundaries and unit locations. Symbols with notations such as A, A1, A2, etc., are used to identify the locations of unit command posts. The names of the highest-level command posts are illustrated at the left.

Functions associated with the battlefield air picture are illustrated as touch-sensitive function keys on the right. These would support change of scale, shift of center, selection of detail to be suppressed, and selection of mission or unit data to be displayed beside or below the air picture.

Air Operations Assessment

EXAMPLE BATTLEFIELD AIR PICTURE

A 51ST MECH TOC
A1 BDE TOC
A2 2D BDE TOC
A3 3D BDE TOC

B 54TH MECH TOC
B1 1ST BDE TOC
B2 2D BDE TOC
B3 3D BDE TOC

C 52ND MECH TOC
C1 1ST BDE TOC
C2 2D BDE TOC
C3 3D BDE TOC

103RD AD:

A4 1ST BDE TOC
B4 2D BDE TOC
C4 3D BDE TOC

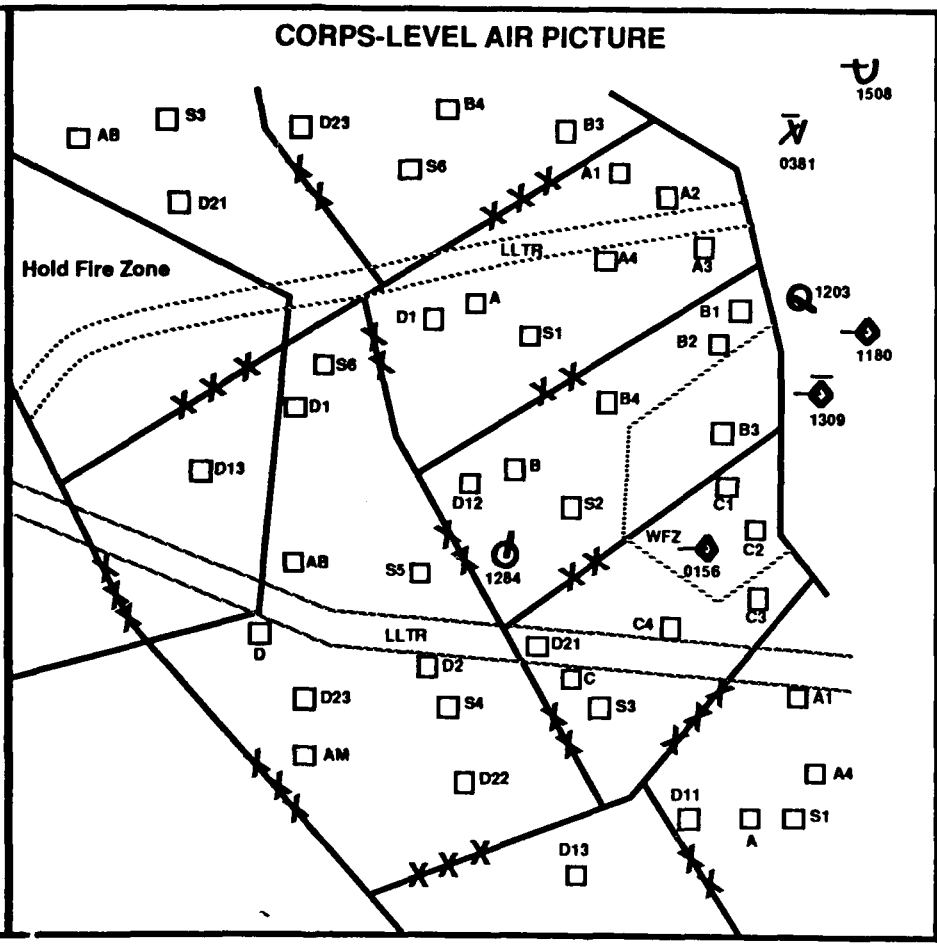
DIV ADMOCs:

S1, S2, S3

HAWK/PATRIOT:

D1, D12, D21
D2, D23, D13

HOSTILE: 1309, 0156, 1180
UNKNOWN: 1508
FRIEND: 1203, 1284
RPV: 0381



ALERT CLEAR
READ MSG
GEN MSG
SELECT GEO
SELECT ALERT
CHANGE SCALE
MOVE CENTER
TRACK DATA
HOOK
DE/ACT ALERT/ ALARM
SET-UP MODE
PRINT
QUIT
PURGE MEM

RPW-12/18/89-1A

While the Army and the Marine Corps conduct many functions procedurally that could benefit from a battlefield air picture, there are no validated requirements documents that call for the use of this capability other than in the support of air defense operations. This chart identifies the primary areas where doctrine and current requirements point to the need for an air picture, and describes the Services' plans to meet requirements in support of low-altitude air defense (LAAD) and areas where concepts related to an air picture are being evaluated in areas other than air defense.

The Army and Marine Corps, as discussed earlier, both have doctrine that calls for close coordination and integration of air support for maneuver operations. In addition, an air picture appears essential to the effective use of VTOL platforms for expanding deep battle and maneuver warfare employment concepts. The Services currently used an air picture integrated with airspace coordination measures to conduct and monitor air defense operations for employment of HAWK and PATRIOT for HIMAD.

In the future, the Army plans to develop and field FAAD C2I to provide an air picture and C2 information to the newly formed Air Battle Management Operations Center (ABMOC), other C2 nodes, and forward units with FAAD weapons. Subsystems are planned for the ABMOC, Army Airspace Command and Control (A2C2) element, FAAD Sensor C2 element, and Battery Command Post. FAAD C2I is designed to handle operations through a division area, but would not support the long-range planning required for corps area operations or certain functions used in HIMAD systems. The FAAD C2I program plans the acquisition of a robust NDI ground-based radar (this is referred to as the Ground-Based Sensor and is the "intelligence" component of FAAD C2I; there are also plans for an aerial sensor). The Marine Corps, on the other hand, does not have a stated requirement for an ADP-supported C2 system for LAAD or even for the development and distribution of an air picture. The plans for LAAD support are associated with the NDI acquisition of a low-cost, short-range air defense radar capability to alert and cue the LAAD teams. This program is called Low Level Early Warning Defense System (LLEWDS).

Both Services are evaluating concepts for using an integrated air-ground situation display for fire support coordination, air traffic control (ATC), and other aspects of airspace coordination and integration (e.g., deconfliction). The Marine Corps developed a significant capability for this in MIFASS (perhaps the most successful part of the MIFASS program) as the Dynamic Situation Display (DSD). Requirements for this capability were not included in the ROC for the follow-on concept, FIREFLEX.

In reviewing ROCs and O&O plans, there were found only implicit requirements related to providing ADP support associated with an air picture. However, the Army's Air Traffic Services Concept Development document[9] for a Tactical Airspace Integration System (TAIS) does specify a need for an air picture and situation display. Further, A2C2 doctrine[10] calls for coordination using information that would be provided in a battlefield air picture, and Combined Arms Center (CAC) developed a concept for an air picture demonstration.[11] The Army methods of airspace control also refer to both a radar and nonradar environment, with the need expressed to be able to exercise positive control favoring a radar environment. The Marine Corps indicates no air picture requirements for the DASC; however, conversations with aviation C2 representatives do indicate a need for a DASC air picture.

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9 Briefing on Tactical Airspace Integration System (TAIS), 1987. A draft O&O plan has reportedly been prepared, but is not approved by the originator and is not yet available.

10 *Army Airspace Command and Control in a Combat Zone,* FM 100-103, HQDA, October 1987.

11 Briefing on Army Airspace Command and Control (A2C2) Air Picture Analysis, U.S. Army Combined Arms Center, 1986.

Air Operations Assessment

STATUS OF AIR PICTURE REQUIREMENTS

- **BOTH ARMY AND MARINE CORPS**
  - Have doctrine calling for close coordination and integration of air support for maneuver operations
  - Use VTOL platforms for expanding deep battle and maneuver warfare force employment concepts
  - Use high-altitude air picture for air defense
- **IN THE FUTURE, FOR LOW-ALTITUDE AIR DEFENSE:**
  - Army has stated requirements for a distributed air picture for FAAD C2I and plans acquisition of a robust ground-based radar system
  - Marine Corps plans acquisition of a low-cost, short-range air defense radar capability [LLEWDS–Low-Level Early Warning Defense System] to alert and queue LAAD units
- **BOTH SERVICES EVALUATING CONCEPTS FOR USING INTEGRATED AIR-GROUND SITUATION DISPLAY FOR FIRE SUPPORT COORDINATION, ATC, AND AIRSPACE COORDINATION**

RW-11/15/89-1

Current uses of an air picture for the Army and Marine Corps involve primarily air defense surface-to-air missile (SAM) and fixed-wing counterair operations. These are supported by the AN/TPQ-73 MISSILE MINDER for HAWK C2 and the PATRIOT Information Coordination Central (ICC) for PATRIOT C2. Additionally, the Marine Air Traffic Control and Landing System (MATCALS) uses a radar air picture for air traffic services to control aircraft approach and provide terminal control. For many years the Marine Corps has had tactical data systems to support the Tactical Air Command Central (TACC): AN/TYQ-1 and AN/TYQ-3A. These will be replaced by the developmental Advanced Tactical Air Command Central (ATACC). Finally, the Joint program of the Marine Corps and the Air Force has completed development of the Tactical Air Operations Module (TAOM) and the Modular Control Equipment (MCE). The TAOM is being fielded to the Tactical Air Operations Center (TAOC) to support conduct of HIMAD C2 with HAWK units. It also supports navigation and air traffic control. The MCE has nearly the same functionality as the TAOM, except that the Air Force passes correlated radar tracks to the MCE, whereas the Marine Corps passes raw radar information to the TAOM for correlation.

Neither Service currently has ADP C2 support for LAAD, although, as previously discussed, the FAAD C2I program will address this area for the Army. Further, neither Service has yet developed ADP C2 support for the nodes that perform airspace coordination: A2C2 and the DASC. The IDASC has a switchboard from the MIFASS program, but no automation support. There is also no automation or even electronic control capability in the Army's Flight Operations Centers (FOCs) and Flight Control Centers (FCCs). The TAIS program is designed to support the FOCs and FCCs, but there are no specific development plans. FAAD C2I is being examined for the TAIS and already plans to provide a subsystem to the A2C2. In addition, the Army is exploring concepts for a HIMAD C2IE module that can control SAM engagement operations for both HAWK and PATRIOT systems [examples are the Command Post Automated System concepts being developed at PM ADCCS and the SAM Operations Center (SAMOC) concept being developed with the Federal Republic of Germany by Air Defense Artillery School].

Since the A2C2, TAIS, IDASC, and LAAD have no automation support today for C2, these C2IE elements and systems would be the principal users that would benefit from access to a battlefield air picture. The Army is already planning a low altitude or "mud" air picture for FAAD C2I and specifically for the A2C2 cells at division and brigade. Air picture support for Army's air traffic service FOCs and FCCs could also be met, eventually, by the FAAD C2I air picture. However, as will be shown in charts that follow, an interim capability for a battlefield air picture for these C2IE elements could be provided before FAAD C2I IOC without a major investment.

Air Operations Assessment

USES OF AIR PICTURE IN C2 SYSTEMS

	CONCEPTUAL	DEVELOPMENTAL	FIELDED
Army:	• A2C2 Support (airspace coordination) • TAIS (air traffic services, aircraft terminal control)	• FAAD C2I (ABMOC and low-altitude air defense units)	• HAWK TPQ-73 (HIMAD) • PATRIOT ICC (HIMAD)
Marine Corps:	• IDASC Automation (air support coordination) • LAAD (low altitude air defense)	• ATACC (command and control)	• MATCALS (approach and terminal control) • TACC (command and control) • TAOM for TAOC (air defense, navigation, and air traffic control)

MAJOR POTENTIAL USERS

RPW 12-18-89-20

The impact of a "mud" air picture could be significant. This chart identifies examples of the range of improvements in operational terms that would be directly related to use of a battlefield air picture.

First, the battlefield perspective would be three-dimensional vice planar. For the first time, the commander and staff would be able to monitor all maneuver and deep battle operations on a real or near real-time basis. FAAD and LAAD operations could receive surveillance and alerting air track information and engagement orders. All combined arms would be less restricted in employment. Artillery could fire quicker and air support would be freer to maneuver. Consequently, supporting combined arms should be more effective. Air traffic services would be enhanced for night and adverse weather operations with a faster tempo and sustained momentum. Further, less restrictive set aside of dedicated airspace would be possible. Finally, with positive control using electronic means, where appropriate, there would be reduced probability of fratricide.

In summary, all of the above would, in turn, provide faster reaction times to know enemy dispositions and would support the major maneuver warfare objective of being able to work inside an enemy's decision cycle.

Air Operations Assessment

BENEFIT OF BATTLEFIELD AIR PICTURE

- **USE OF BATTLEFIELD AIR PICTURE COULD LEAD TO IMPROVEMENTS SUCH AS:**
  - -- Improved battlefield orientation and control of maneuver forces
  - -- Closer coordination of combined arms (time and space) and improvement effectiveness
  - -- Increased capability to conduct night and adverse weather operations
  - -- Better air traffic services support for night and adverse weather operations
  - -- Less restrictive set aside of dedicated airspace
  - -- Lower probability of friendly losses due to friendly fires
  - -- Achievement of maneuver warfare objectives as a consequence of being able to operate inside the enemy's decision cycle

RPW 11-22-89-22B

There are opportunities to provide a comprehensive air picture or to improve the partial air pictures provided today. These are directed at improving access to air track and positional information, such as from tactical data links (TADILs), tactical data systems, position reporting systems, and additional radar systems, and improving the dissemination and ability to display the air picture.

One option would be to provide TADIL A access to both air and ground transmitters--such as the TAOC or E-2/E-3 air platforms--for display or redistribution. This concept for air picture forwarding was successfully demonstrated in the 1989 Fort Bliss ROVING SANDS exercise, in which TADIL A links were provided directly to the 11th ADA Brigade AN/TSQ-73 from the AWACS and the TAOC. These links could also be used to pass an air picture to A2C2 cells and FOC and FCCs (TAIS) either directly or through a TSQ-73 or future air defense module. The Marine Corps DASC could also receive TADIL A information through a TAOM.

Interfaces to tactical data systems such as the AN/TSQ-73, TACC, TAOC, and NTDS (e.g., via TADILs A, B, or J) could be provided for access to developed air pictures. Further, when FAAD C2I is fielded, a divisional air picture could be provided over TADIL J.

Availability and use of position location information (PLI) could be increased. When Army and Marine Corps EPLRS/PLRS are in place, battlefield helicopters equipped with a PLRS device would provide a significant improvement in the air picture. This is particularly true since low flying helicopters are often difficult to track with ground-based radar systems.

Additional ground-based sensors could also be employed and netted into existing air defense systems for improved low altitude coverage. However, there will frequently be situations where the best air picture, due to the existing tactical situation or radar masking terrain features, will only be available from airborne platforms. Both the Army and Marine Corps would benefit from sensors on remotely piloted vehicles or additional E-2/E-3s made available for land warfare operations.

For many years, the U.S. Navy has fielded automated displays of surface and air track information. Recently, technology has permitted moving these displays from desktop consoles to medium-, large-, and flat-wall-screen displays. These dynamic displays of both surface and air information give commanders, staff, and weapon/air controllers an orientation that is incredibly superior to maps, acetate overlays, and non-moving non-real/near-real time fixes. The JOTS and FDDS are components of the Tactical Flag Command Center (TFCC) improvements that are planned for all C2 ships, including those for amphibious C2. Access to the Navy's air picture is already provided through Joint Tactical Air Operations (JTAO) procedures. The TFCC improvements include large-screen displays that could be considered for use elsewhere for display of the battlefield air picture.

Finally, in the future, if a highly mobile C2 module for both low- and high-altitude air defense operations could be developed with common interfaces and communication devices, this module could pass air picture information to a multitude of systems such as FAAD, LAAD, TAOC, TACC, DASC, CRC, TAIS, A2C2, AN/TSQ-73, and PATRIOT ICC.

Air Operations Assessment

OPPORTUNITIES TO IMPROVE AIR PICTURE

- PROVIDE TADIL A ACCESS TO AIR AND GROUND TRANSMITTERS FOR USE BY A2C2 CELLS, TAIS NODES, AND DASC
- PROVIDE FAAD C2I TRACK INFORMATION TO A2C2, TAIS, DASC, AND TAOC
- PROVIDE WIDER DISTRIBUTION OF TRACK DATA AVAILABLE FROM TSQ-73, TACC, AND TAOC
- INCREASE AVAILABILITY AND USE OF PLI
- FIELD ADDITIONAL GROUND-BASED SENSORS AND EMPLOY MORE AIRBORNE SENSORS
- EXPLOIT NAVY'S CORRELATED DISPLAY FOR TFCC
- DEVELOP HIGHLY MOBILE C2 MODULE FOR FUTURE AIR DEFENSE C2

RPW 12-18-89-22

As indicated earlier, both the DASC and the FSCC would benefit from access to information from the maneuver control and fire support systems for use in preparing, disseminating, and receiving messages regarding aircraft status, fragmentary orders, and the air tasking order, as well as accessing and updating intelligence provided to and obtained from aircrews and data pertaining to fire support, direct air support, and assault support missions. The chart shows additional improvements to the DASC and FSCC that are related to the battlefield air picture.

Providing selected air tracks and an automated large-screen display of direct air and assault support mission data for requested, planned, approved, and airborne missions would supplement the current voice-manual means for reference mission data, air tracks, and the integrated battlefield orientation needed for coordination and planning functions.

A single TAOM module could be deployed in proximity to the DASC with a direct interface. The air picture and communications would support air support coordination and air resource management functions performed in the DASC. The TAOM module could capture the Navy Link 11 and JTAO air picture as well as directly interface with E-2 and E-3 air platforms. These air platforms would, when available and prior to setting up ground radars, provide a low-altitude air picture. Further, early emplacement of a single TAOM module would permit automated air defense engagement operations between the Navy AAW CIC and the HAWK Battery or platoon command post controlling missile launchers.

The battlefield air picture could be transmitted directly into the FSCC from a TAOM or DASC. A weapons display workstation in the FSCC would support field artillery deconfliction. The coordination process would be expedited when aircraft and artillery deconfliction could take place in the FSCC. Coordination and deconfliction could be supported by an Augmentation Team from the DASC assigned to the senior FSCC. Also, with fewer restrictive airspace coordination measures, aircraft would be freer to maneuver. Airspace coordination measures for field artillery would essentially be done on an expedited basis by exception. Rapid FSCC clearance would enable aircraft to be freer to fly and field artillery batteries freer to fire.

Finally, the DASC with a battlefield air picture could be employed as a forward or alternate TACC. Many MEU- and MEB-sized operations will not include a full-size TACC with the ATACC system. The DASC in these situations automatically carries out a portion of TACC responsibilities for air resource management. Providing the DASC an air picture and automated TADIL interface with the TAOC or TAOM permits limited TACC-level activities in the DASC. Further, should the TACC be disabled, the DASC with an air picture and improved facilities would have a better perspective to assume TACC alternate responsibilities (vice the TAOC).

Air Operations Assessment

ADDITIONAL OPTIONS FOR MARINE CORPS

- PROVIDE ADP SUPPORT IN DASC FOR:
  - -- Messages, plans, frag. orders, and database access to intelligence (TCO/FIREMAN terminal)
  - -- Access to fire support, direct air, and assault support data (FIREFLEX terminal)
  - -- Access to air mission data (large-screen display)
  - -- Mud air picture with selected air tracks (displays interfaced to TAOM)
- PROVIDE MUD AIR PICTURE TO FSCC FOR:
  - -- Field artillery deconfliction
  - -- Air support coordination by DASC Augmentation Team
- CONSIDER USING ADP-ENHANCED DASC AS:
  - -- TACC (FWD)
  - -- TACC Alternate (vice TAOC)

RW-11/15/89-4A

There are two major conclusions from the air operations assessment regarding a battlefield air picture. First, the Army and the Marine Corps need to specify both general and detailed ADP support requirements for integration of a battlefield air picture in ATCCS and MTACCS, specifically in the systems planned for support of maneuver control, fire support, and airspace control. Requirements for a battlefield air picture are not yet explicitly identified in the ROCs for systems in these areas. Further, there are no documents yet prepared that would define the user requirements for the functionality and information exchange that would be associated with a battlefield air picture. Since the need and benefit of a battlefield air picture is significant for both Services, the users of both Services should coordinate requirement specification activities.

The Services should also work together to exploit the opportunities that have been identified for obtaining air track information, integrating that information with the battlefield situation, and disseminating and displaying the battlefield air picture wherever required. Some of these development activities can be expected to take place under the programs of the aviation C2 program managers. Exploiting the full potential of a battlefield air picture will require support from the the Ground C2 program mangers in the maneuver control and fire support areas. In the Army, this would include exploiting as soon as possible the technology being developed for FAAD C2I and examining additional options for obtaining a battlefield air picture from other sources and by other means, at least until FAAD C2I is fielded. For the Marine Corps, this would mean exploiting use of the TFCC improvements and the capabilities of the TAOM, and integrating these into FIREFLEX, FIREMAN, and TCO, as well as the DASC, as required.

The Services should also cooperate on initiatives to address the deficiency in providing surveillance information for low-altitude aircraft. Both Services have very different programs to address this problem by fielding ground-based radars.

Second, looking at the long term, the Services will be examining evolutionary improvements in existing systems and, possibly, a new common air defense module, to develop and disseminate a battlefield air picture. Such a module could be a future follow-on to the AN/TSQ-73, the PATRIOT ICC, and the TAOM for use in support of air defense operations. A substantially down-sized version of the MCE/TAOM would be one of the starting points for such a development program. Potentially, some elements of the FAAD C2I program would be candidates for such a common module, and these should be considered when completed. While the initial focus of development for support of a battlefield air picture would be on access to and integration of existing partial air pictures and battlefield situation data, the long-term initiatives are needed to provide a low-cost, easily transportable module that could perform the air track correlation, identification, and integration functions essential to both air defense and to other tactical uses of a battlefield air picture.

Air Operations Assessment
CONCLUSIONS

- SERVICES NEED TO SPECIFY ADP SUPPORT REQUIREMENTS FOR INTEGRATION OF BATTLEFIELD AIR PICTURE IN MANEUVER CONTROL, FIRE SUPPORT, AND AIRSPACE CONTROL

- MCE/TAOM POTENTIAL STARTING POINT FOR AIR DEFENSE C2 COMMON MODULE AND BATTLEFIELD AIR PICTURE DISSEMINATOR (CONSIDER ALSO ELEMENTS OF FAAD C2I)

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5. INTEROPERABILITY ASSESSMENT

This section highlights a number of interoperability issues that were addressed in the course of the other assessments. These issues focus on improvements in the use of standards, data management, and open systems data communications protocols in moving toward improved potential for interoperability and cost savings.

Background for standards and data management is followed by a brief discussion of some principles adopted in these two areas by a SHAPE-sponsored study--Army Tactical Command and Control Information System (ATCCIS)--that emphasizes achieving interoperability while preserving the greatest possible latitude for the nations who adopt the recommendations and implement a conformant architecture. The background is completed with a discussion of protocols and the status of international civil standards for open systems interconnection (OSI), and the U.S. and NATO efforts to ensure that military standards based on OSI can support all the required military features.

The assessment considers the principles identified in the background, the current efforts by the Army and the Marine Corps to achieve interoperability within ATCCS and MTACCS, respectively, and the potential benefits of the Services working together in the areas of standards, data management, and protocols. The section ends with a list of some options that could potentially improve Joint interoperability and several conclusions.

INTEROPERABILITY ASSESSMENT

- FOCUS: STANDARDS, DATA MANAGEMENT, PROTOCOLS
- BACKGROUND
- ASSESSMENT
- OPTIONS TO IMPROVE JOINT INTEROPERABILITY
- CONCLUSIONS

RPW-12/15/89/5

This chart provides the definition of interoperability that is agreed to within the United States (JCS Pub 1) and among the NATO nations (NATO Glossary[12]): "the ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together." The "services" in this definition when applied to information systems, such as tactical data systems that support command and control, are generally understood to mean the exchange of information. The term "information" carries the connotation of a meaningful operational context that goes beyond the values of the data elements involved in the exchange. The NATO Interoperability Management Plan (NIMP)[13] identifies five classes of services applicable for information exchange: reporting, data exchange (between databases), remote service, electronic mail, and conferencing.

Three classes of standards are used to ensure interoperability:[14]

- Operational interoperability standards specify the meaning, content, and employment of information to be exchanged, independent of the systems used to fulfill the validated information exchange requirements (IERs)
- Procedural interoperability standards specify (1) the procedures regarding the form in which the information to be exchanged between information systems is transferred, (2) the standard reporting language, and (3) the operating procedures for the data links. Procedural standards include messages, rules for structuring messages, and rules for representing the data. Procedural standards also include communications standards for the transmission protocols to transfer messages through the communications medium, such as operating procedures for data links and for services such as voice or teletype.
- Technical interoperability standards specify the functional, electrical, and physical characteristics of equipment conducting information exchange. In NATO, they are specifically directed to be developed in accordance with the seven-layer Basic Reference Model for Open Systems Interconnection. These standards are to satisfy specific elements of IERs by standardizing the set of necessary services to be executed between the functions of the interfacing layers of the Model and between the transmission medium and its adjacent layer in the model, and by establishing standard protocols for all layers.

The emphasis on content, meaning, and employment of information to be exchanged means that comprehensive data management features need to be in place to make the standards work. Specifically, this means (NIMP, 3.3.1) that a common information exchange glossary is essential to the development of unambiguous and operationally satisfactory information procedural standards. Further, this involves the naming conventions used for information items and formally controlled data elements, and the overall information model used to guide the design of systems that can support database-to-database exchanges (whether directly or through messages).

Reliance on standards and data management alone will not ensure interoperability. Standards have to be agreed to and enforced at the option and detailed parameter levels. Further, the potential for interoperability is enhanced, and the cost of achieving the required degree of interoperability is, potentially, significantly reduced if sound system engineering practices and design principles are adopted. Examples of such principles are given in the next chart.

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12 AAP-6(Q), *NATO Glossary of Terms and Definitions for Military Use*. Note that NATO's ADatP-2 defines interoperability of a data processing system as the "ability of a data processing system to provide services to and accept services from other data processing systems."

13 *NATO Interoperability Management Plan (NIMP)*, Second Edition, AC/259-D/1274 (Revised), 1988.

14 Specifications for these classes are taken from the *NIMP*, Section 3.

Interoperability Assessment

BACKGROUND

- **INTEROPERABILITY: ABILITY OF SYSTEMS, UNITS OR FORCES (JCS PUB 1, NATO AAP-6):**
  - **To provide services to and accept services from other systems, units, or forces**
  - **To use the services so exchanged to enable them to operate effectively together**
- **INTEROPERABILITY REQUIRES:**
  - **Operational, procedural, and technical standards**
  - **Comprehensive data management (e.g., glossary, naming conventions, data elements, information model)**
  - **Comprehensive systems engineering and sound design principles**

RPW/12-15-89-6A

This charts gives examples of some of the principles that have been adopted by ATCCIS, a SHAPE-sponsored study for the interoperability of command and control information systems (CCISs) for the Year 2000 and beyond.[15] The technical goal of ATCCIS is to define the minimum architectural elements and services that the nations can agree to implement in a standard way that ensures interoperability without unnecessarily constraining national options. ATCCIS concepts are being developed by military and technical experts of four nations: France, Germany, the United Kingdom, and the United States.

In ATCCIS, Basic Interoperability is defined as the exchange of data that preserves the meaning and relationships of the data exchanged. This is viewed as the minimum level of required interoperability for CCISs, and the ATCCIS architecture is defined to provide the services required to support it. ATCCIS has evaluated alternatives and recommended the concepts of partitioning the database (partitions would be, in part, according to data ownership or by responsibility for maintaining currency) and partially replicating the database (not every node needs all the data and not every copy of the data has to be automatically updated when the values change at the controlling location--in such cases the updated values are automatically provided when accessed).

ATCCIS recommends provision, where possible, for efficient exchange of database updates. The ATCCIS architecture provides for database-to-database exchanges. However, the assessment of technical standards recognizes that the currently defined message texts formats and data link messages may not be satisfactory as procedural standards. Further, it is not yet clear if the OSI standards, using the Message Handling System or the File Transfer and Management protocols, will be satisfactory and whether the overhead associated with the OSI Abstract Syntax Notation is acceptable for tactical applications.

ATCCIS recommends the architecture be implemented by specifying standards, options within standards, and profiles of standards and by specifying at the lowest required level the interoperability parameters (such as design values) to be controlled. ATCCIS recommends the use of international commercial OSI protocols whenever possible.

Further, ATCCIS recognizes that agreeing to standards (e.g., Ada, POSIX) that go beyond the minimum for Basic Interoperability could lead to substantial cost savings. These include the common use of standards and NDI (such as commercial off-the-shelf software and hardware) that minimize the need for new development and enhance software portability and reusability. Adopting such standards and commonality is termed in ATCCIS "Enhanced Interoperability."

As a final example, ATCCIS calls for exploiting long-haul communications when and where possible. This includes the use of commercial Post-Telephone-Telegraph systems of the host nations. For the United States it would include provision for use of the Defense Data Network (DDN).

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15 *ATCCIS Working Paper 7L, Operational and Procedural Requirements for Data Management and Standardization,* Edition 1.0; *ATCCIS Working Paper 24, Architecture Definition,* Edition 2; and *ATCCIS Working Paper 25, Technical Standards for the ATCCIS Architecture,* Edition 1.2.

Interoperability Assessment

SOME PRINCIPLES PROPOSED IN ATCCIS FOR ACHIEVING INTEROPERABILITY OF YEARS 2000+ TACTICAL C2 SYSTEMS

- AT THE MINIMUM, SUPPORT THE EXCHANGE OF DATA THAT PRESERVES MEANING AND RELATIONSHIPS ("BASIC" INTEROPERABILITY)
- PROVIDE DATA MANAGEMENT TO ENSURE COMMON INTERPRETATION OF DATA EXCHANGED, ESPECIALLY FOR DATA ELEMENTS AND DATA DEFINITIONS
- SUPPORT PARTITIONED AND PARTIALLY REPLICATED DATABASES
- PROVIDE CAPABILITY FOR EFFICIENT EXCHANGE OF DATABASE UPDATES (EXISTING FIXED-FORMAT MESSAGES MAY NOT BE SATISFACTORY)
- AGREE ON TECHNICAL, PROCEDURAL, AND OPERATIONAL STANDARDS AND, EVENTUALLY, ON OPTIONS AND SPECIFIC INTEROPERABILITY PARAMETERS; USE INTERNATIONAL CIVIL (e.g., OSI) STANDARDS WHERE POSSIBLE
- CHOOSE, WHERE POSSIBLE, STANDARDS (e.g., Ada, POSIX) AND NDI (e.g., COMMERCIAL OFF-THE-SHELF SOFTWARE) THAT MINIMIZE NEW DEVELOPMENT AND ENHANCE SOFTWARE REUSABILITY AND PORTABILITY WITHOUT UNDULY RESTRICTING NATIONAL AND SYSTEM-LEVEL OPTIONS ("ENHANCED" INTEROPERABILITY)
- BE CAPABLE OF EXPLOITING LONG-HAUL COMMUNICATIONS WHEN AND WHERE AVAILABLE

RPW-10-20-89-10

Substantial progress has been made by the International Standards Organization (ISO) and the International Telephone and Telegraph Consultative Committee (CCITT) in the area of data communications standards for open systems interconnection (OSI). Many of the standards have been formally adopted as International Standards and many others are within 1or 2 years of final approval. There is great commercial interest in using the standards, partly as a result of intense pressure from procuring bodies to eliminate proprietary architectures and standards. Profiles of these standards are being developed to narrow down the options and interoperability parameters so that products built to these profiles will, in fact, interoperate even when developed independently by different manufacturers. The United States has formally adopted an initial profile called the Government Open Systems Interconnection Profile (GOSIP) and by specifying it as a Federal Standard mandated it for future procurements.

The Tri-Service Group on Communications and Electronics Equipment (TSGCEE) has been monitoring the progress of OSI standards for many years. NATO has now mandated OSI standards for use as the basis for NATO technical interoperability standards. In the early 1980s, TSGCEE identified eight military features that appeared not fully satisfied by the emerging standards. These are (1) multihomed and mobile-host systems, (2) multi-endpoint connections (multi-addressing, also known as multipeer data transmission), (3) internetworking, (4) network or system management functions, (5) security, (6) robustness and quality of service, (7) precedence and preemption, and (8) real-time and tactical communications. Some of these (e.g., internetworking) are now covered by the standards and are no longer a major concern. Others would require extensions, options, or other provisions when they are adopted as a NATO Standardization Agreement (STANAG). However, the drafting of these STANAGs is proceeding very slowly. Until the STANAGs are complete, TSGCEE has recommended a set of commercial standards and is developing profiles of the standards.[16]

The U.S. effort in protocol development in general and specifically in assessing the need for military features is now focused in the Protocol Standards Steering Group (PSSG). Through a technical panel and a number of working groups, the PSSG is actively working to develop military supplements to the GOSIP so that procurement authorities can specify the supplement when they specify GOSIP. The initial deadline for the supplement for GOSIP 1.0 is August 1990, when GOSIP is mandatory for military procurements.

OSD has directed that each Service and Agency develop a transition plan to show how GOSIP will be migrated into the communications and information system architectures for the near- and far-term. The deadline for these plans was August 1989, but many have not been submitted in final form. Further, some of them do not anticipate use of GOSIP for tactical systems.

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16 *NATO Technical Interoperability Standards Transition Strategy,* AC/302-D/347(Revised), CNAD/TSGCEE, 29 September 1989.

Interoperability Assessment

BACKGROUND ON OPEN SYSTEMS DATA COMMUNICATIONS PROTOCOLS

- CIVIL OPEN SYSTEMS STANDARDS FOR DATA COMMUNICATIONS PROTOCOLS ARE MATURING
  - -- ISO and CCITT have made great progress in the protocols
  - -- Eight military features were identified in NATO in the early 1980s as areas not adequately addressed in OSI standards
  - -- TSGCEE SG9 is (slowly) developing STANAGs to use civil OSI standards for data communications with military "enhancements"
  - -- U.S. effort is now focused in Protocol Standards Steering Group (PSSG)
- TRANSITION TO CIVIL PROTOCOLS IS MANDATED BY GOSIP
- SERVICES AND AGENCIES ARE REQUIRED TO PROVIDE TRANSITION PLANS

RPW 12-18-89-25

Both the Army and the Marine Corps have efforts underway and specified standards for achieving interoperability among the tactical data systems (TDSs) within the Service architectures, ATCCS and MTACCS, respectively. These initiatives include the ATCCS and MTS standards, information exchange requirements (they are more nearly complete in the Army than in the Marine Corps), use of nonproprietary software and hardware interfaces (this is more true of the ATCCS CHS than of other initiatives), and use of NDI and commercial off-the-shelf products. Because of previous investments in special-purpose standards, it will be some time before the fully automated forms of interoperability (e.g., for data exchange among the five Army control systems) are achieved. Obtaining system engineering services for ATCCS is a major step in this direction.

More could be done. One example would be extending and broadening the cooperative efforts between the Army and the Marine Corps that were developed in 1989. This could lead to multi-Service CASS and possible fielding of the same systems for both fire support and maneuver control. Further, as CASS nears its goal, there is greater potential to achieve the close integration of fire support and maneuver that is required for effective employment of combined arms. As suggested earlier in the briefing, one of the elements of CASS could be a module providing support for the battlefield air picture and other modules that enable the Services to exploit access to tactical data links where available.

Use of OSI protocols in tactical systems would permit much of the software associated with modems, interface units, and interface processing to be NDI, commercial off-the-shelf, or even available in firmware supporting open architectures. The great potential for long-term acquisition and maintenance cost benefits makes it critical for the Services to explore all possible options for using OSI or, where necessary, obtaining some extensions to the OSI.

The need for efficient data exchange between tactical data systems could lead to the adoption of operational interoperability standards that use a high degree of coding and representations for data objects (including graphical symbols). In addition, where agreements about what has to be sent can be made in advance, procedural means that are more efficient than message text formats may be required. An example would be the use of the message syntax permitted in TADIL J for variable formatted messages and adopted by the Army and the Marine Corps for use with the JINTACCS K-Series fire support messages. These are bit-oriented messages very similar to those in the MTS standard.

The Services and Agencies need to work with the PSSG to develop both long-term as well as short-term plans for influencing the direction and services provided by the emerging international standards. In September, the United States (through its representative to TSGCEE Subgroup 9) recommended multipeer data transmission become a major U.S. initiative. However, the termination of the ISO effort in its architecture working group (SC21/WG1) could mean that another focus should be adopted. In any case, DoD needs to concentrate its efforts and provide resources to move this work forward. At its December 1989 meeting, the PSSG working group on lower-layer OSI protocols agreed to include development of a long-term plan as a work item. Protocol work is likely to take many years even if aggressively pursued.

Finally, as identified in the fire support assessment, agreement on the joint protocol to be used with the K-Series messages in AFATDS is needed for Version 1. These protocols could be replaced by an OSI-based or GOSIP-compliant set when such a set is adopted by the PSSG.

Interoperability Assessment

ASSESSMENT

- ACHIEVING BASIC INTEROPERABILITY AMONG TDSs FOR ATCCS AND MTACCS APPEARS ACHIEVABLE
- CONTINUING CURRENT COOPERATIVE MULTI-SERVICE EFFORTS COULD ALSO IMPROVE POTENTIAL AND REDUCE COST OF JOINT INTEROPERABILITY
- TACTICAL USE OF CIVIL OPEN SYSTEMS PROTOCOLS COULD LEAD TO MAJOR COST SAVINGS FOR TDSs
- NEED FOR EFFICIENT DATA EXCHANGE COULD LEAD TO EXTENSIVE CODING AND MORE EFFICIENT SYNTAX (e.g., BIT-ORIENTED MESSAGES)
- WORK STILL NEEDS TO BE DONE TO INFLUENCE THE CIVIL STANDARDS AND ACHIEVE TACTICAL APPLICATIONS
- AGREEMENT ON JOINT PROTOCOL FOR AFATDS IS NEEDED PENDING AGREEMENT ON OPEN SYSTEMS PROFILES FOR TACTICAL SYSTEMS

RPW/12-15-89-7

This chart identifies some options that can be taken by one or both the Army and the Marine Corps to improve interoperability.

The Marine Corps needs to specify more fully the interfaces between the MTACCS systems supporting Ashore C2 and those systems supporting Afloat C2. There will be some systems in common, and these systems can be expected to have interfaces to both areas. Some of the systems are expected to have TADIL B and JTIDS to distribute the air picture for air operations and for the battlefield air picture needed for fire support and maneuver. PLRS is being fielded to both ground units and aircraft, but there is yet only a prototype capability to integrate PLRS with Ashore C2 systems (PLRS is already integrated to systems in the TFCC). Further, the Marine Corps needs to complete requirements for PLI integration and distribution so that these requirements can be addressed by multi-Service efforts in fire support and maneuver. Finally, the DCT will be widely used by the Marine Corps, as well as by all the other Services.

The Army and the Marine Corps need to complete work to implement fire support information exchange with the agreed-to JINTACCS K-Series messages and MTS protocol, modified where necessary, in Version 1 AFATDS. It is possible that without additional work by both Services, both the broadcast and switched MTS protocols, as well as the modified broadcast protocol for the K-Series messages, will be needed in Version 1 AFATDS.

The four Services could jointly explore the adoption of a single standard for the exchange of C2 information between digital forward entry devices and tactical data systems. This was an issue raised by JTC3A in the Fire Support Functional Interoperability (Joint) Architecture, now validated by the Joint Staff and approved by OSD.

The Army, Navy, and Marine Corps could continue to explore adoption of common standards for equipment, software, data management, and other areas for ATCCS, MTACCS, and naval systems, such as the TFCC. This work could lead to such goals as a common information mode, a common approach to data standardization, and a compatible Commander's database that could support database-to-database exchanges. Even if a common data element dictionary could not be achieved, the use of compatible or common naming conventions and object identification structures could lead to translatable data elements and comparable information models.

Interoperability Assessment

OPTIONS TO IMPROVE INTEROPERABILITY

- SPECIFY MORE FULLY THE INTERFACES BETWEEN TFCC FOR AMPHIBIOUS C2 AND MTACCS C2 ASHORE
  - Use of TADIL B and JTIDS to distribute air picture
  - Use of PLRS to distribute and integrate PLI
  - Use of DCT over combat net radio, with MTS messages and protocols to transmit C2 information
- IMPLEMENT FIRE SUPPORT INFORMATION EXCHANGE WITH K-SERIES MESSAGES AND (POSSIBLY MODIFIED) MTS PROTOCOL IN AFATDS VERSON 1
- EXPLORE THE ADOPTION OF A SINGLE STANDARD FOR EXCHANGE OF C2 INFORMATION BETWEEN DIGITAL FORWARD ENTRY DEVICES AND TDSs
- CONTINUE TO EXPLORE ADOPTION OF COMMON STANDARDS FOR ATCCS AND MTACCS AND ADDRESS STANDARDIZATION WITH NAVAL C2 SYSTEMS (e.g., TFCC)
- CONSIDER EVOLVING MTACCS AND ATCCS TO:
  - Common information model
  - Common approach to data standardization
  - Compatible Commander's databases that could support database-to-database exchanges

RPW 11-22-89-12

Work in NATO and the nations, including the United States, on the military requirements still has not led to a definitive understanding of whether civil (e.g., OSI) standards will be adequate for tactical military applications. For example, there has not been good analysis, experimentation, and testing to see how well profiles and stacks (e.g., short stacks) of selected protocols could support near-real-time or real-time data transfer. Nor have the Services analyzed the operational impact of accepting less than the desired performance from the civil protocols.

Increased support and better coordination is needed for U.S. efforts to permit DoD to influence the emerging standards and to ensure the resulting standards provide the features required for the military, especially for tactical applications.

Transition plans need to be completed and the transition process will require proactive efforts by the Services and Agencies. These efforts will require planning, study, analysis, experimentation, and testing. Close consultation with the communications vendors and users may be required to get optimal results.

Information exchange can potentially be more efficient in the use of communications when computers can manage the flows without having human readability. These exchanges can rely on computers to accurately code and decode representations of data and to use highly efficient syntaxes to manage the data exchange and protocols to carry the data over communications media. JINTACCS Message Text Formats (MTFs) were designed for human readability and computer support for composition and message management, but these messages may not be suitable for the database-to-database exchanges anticipated among future tactical data systems. A new class of messages, such as the JINTACCS K-Series (variable formatted) messages, may be required. The K-Series messages use, for example, bit flag and bit codes to represent and manage the operational and procedural aspects of the information exchange (there are very few constraints on the protocols that could be used to transfer these kinds of messages on the various communications media).

Effective data management is a key to achieving interoperability as well as for achieving cost savings in developing information systems. The potential for Joint interoperability would be enhanced if the Services coordinated their efforts in this area and used common or compatible data management standards. These efforts could benefit from overall coordination in OSD.

Interoperability Assessment

CONCLUSIONS

- IT IS NOT YET CLEAR IF CIVIL STANDARDS WILL BE ADEQUATE FOR TACTICAL MILITARY APPLICATIONS
- INCREASED SUPPORT AND BETTER COORDINATION OF U.S. EFFORTS ARE NEEDED TO ENSURE DEVELOPING STANDARDS MEET MILITARY REQUIREMENTS
- TRANSITION TO CIVIL OPEN SYSTEM STANDARDS REQUIRES PLANNING, STUDY, EXPERIMENTATION, AND TESTING
- SERVICES NEED TO EXPLORE INCREASINGLY EFFICIENT DATA EXCHANGE AND SYSTEM DESIGN OPTIONS
- POTENTIAL TO ACHIEVE JOINT INTEROPERABILITY WILL BE ENHANCED IF SERVICES WORK TO USE COMMON STANDARDS AND COORDINATE DATA MANAGEMENT

RPW/12-15-89-8

This section identifies some major issues that need to be addressed by the Services. It also summarizes the major conclusions of the study and identifies some actions that could be taken by OSD as a result of the study findings.

SUMMARY

- MAJOR CONCLUSIONS
- POTENTIAL COURSES OF ACTION FOR ARMY AND MARINE CORPS
- POTENTIAL COURSES OF ACTION FOR OSD

RPW 12-18-89-28

The assessments conducted in this study have shown that the Army and the Marine Corps have very similar requirements in three areas: maneuver control, fire support, and use of a battlefield air picture in air operations for airspace coordination and control. In each of these areas there is potential for the Services to cooperatively develop and field common ADP support.

Specifically, the Army and the Marine Corps could field a common objective system for maneuver control and a common system for fire support. A multi-Service program has already begun for fire support, and the Services are now discussing the possibility of a multi-Service program in maneuver control. Further, the Services have a common need and can be expected to develop similar types of support for a battlefield air picture. A multi-Service program for support of the battlefield air picture could be developed (in support of functions other than air defense).

Unless otherwise directed, the Army and the Marine Corps may implement incompatible standards in their tactical data systems for data communications and data management. An agreement has been reached to provide an interim solution to the incompatibility of the Marine Corps switched protocols and the international standard packet-switched protocols planned for MSE's packet-switched overlay. The two Services, however, have not yet agreed on the protocols to be used to support the JINTACCS K-Series fire support messages in AFATDS. Further, the Services have different programs for standardizing data elements and other aspects of data management for tactical (and other) systems.

Summary

MAJOR CONCLUSIONS

- ARMY AND MARINE CORPS HAVE VERY SIMILAR ADP C2 SUPPORT REQUIREMENTS IN MANEUVER CONTROL, FIRE SUPPORT, AND USE OF BATTLEFIELD AIR PICTURE

- THERE IS A POTENTIAL FOR BOTH SERVICES TO FIELD:
  - -- Common objective system for maneuver control
  - -- Common objective system for fire support
  - -- Common ADP support for a battlefield air picture

- UNLESS OTHERWISE DIRECTED, SERVICES MAY IMPLEMENT INCOMPATIBLE STANDARDS FOR DATA COMMUNICATIONS AND DATA MANAGEMENT

RPW 12-18-89-29

This chart identifies several courses of action that could be taken by the Army and the Marine Corps to address the findings and conclusions of this study.

Both Services need to review their current specifications for the type and degree of automation needed to ensure that the appropriate level of detail for ADP support requirements is provided to system developers. The level of detail of the user specification of automation requirements varies greatly between the two Services and among the tactical data systems of each Service. Both Services should consider developing a system to prioritize requirements for each block improvement.

Both Services should continue to reassess the voice and data communications required to support tactical command and control as increasing ADP support is provided in the 1990s and beyond. New assessments should provide a means to estimate the communications required to support information exchange requirements for a range of scenarios and operating conditions, including operation in degraded modes. The Services should consider using the same or compatible assessment models where possible. Potentially, the assessments will lead to additional requirements on tactical data systems that will ensure these systems can operate effectively when fielded communications systems degrade or if enhanced communications systems are not fielded as planned.

As the Army and Marine Corps work together in multi-Service programs for maneuver control and fire support, they should consider the development of concepts that will also apply to the ADP support for Joint Task Force C2. Many of the elements of force-level control, maneuver control, and fire support for (Joint) combined arms operations and MAGTF C2 appear to be very similar to those required for Joint Task Force C2.

The Marine Corps needs to complete work on its revised concept for MTACCS and requirements specification for MAGTF C2 and the four functional areas. Specifically, detailed information exchange requirements are needed to define interfaces among tactical data systems within the functional areas (e.g., between FIREMAN and FIREFLEX) and among the functional areas (e.g., between ATACC and FIREFLEX). Further, the ROC for FIREMAN needs to be approved, and the 1978 TCO ROC needs to be reviewed in relation to the revised MTACCS concept. Finally, detailed ADP functions need to be defined by the users to show the type and degree of automation that is to be developed for the tactical data systems in MTACCS. Examples of such specifications in the Army are the MCS Design Consideration Memoranda (for maneuver and force-level control) and the Red Book (for fire support).

Summary

POTENTIAL COURSES OF ACTION FOR ARMY AND MARINE CORPS

- DETERMINE IF THE CORRECT TYPE AND DEGREE OF AUTOMATION IS SPECIFIED FOR BATTLEFIELD C2 TASKS
- ASSESS ADEQUACY OF EXISTING AND PLANNED COMMUNICATIONS TO SUPPORT TACTICAL DATA SYSTEMS
- DEVELOP CONCEPTS TO IMPROVE ADP SUPPORT FOR JOINT TASK FORCE C2
- MARINE CORPS TO COMPLETE WORK ON REVISED MTACCS CONCEPT AND REQUIREMENTS FOR:
  - -- Exchange of information among the functional areas and between C2 systems
  - -- FIREMAN and revised TCO systems
  - -- Detailed ADP functions for FIREFLEX, FIREMAN, and TCO

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This chart identifies three potential courses of action based on the findings and conclusions of this study.

First, OSD could support Service initiatives that would lead to multi-Service programs to develop common systems for fire support, maneuver control, and a battlefield air picture. A multi-Service fire support program could lead to a common objective system for the Army's AFATDS and the Marine Corps' FIREFLEX in FY94. In addition, a multi-Service maneuver control program could lead to a common objective system for the Army's MCS and the Marine Corps' FIREMAN (and possibly TCO) in FY93. Finally, a multi-Service program could be developed to exploit the opportunities to acquire and distribute a battlefield air picture.

Second, OSD could request the Army and the Marine Corps to provide briefings on the Service efforts to develop and expand multi-Service initiatives, to adopt common standards between the two Services, and to work together towards use of hardware and software common to both Services.

Third, OSD could request DCA and JTC3A to take to actions that would improve progress toward interoperability. One would be to ensure that the Army and the Marine Corps quickly complete their discussions on the initial Joint information exchange standards to be used in Version 1 AFATDS. Unless agreement is reached, the Services could rely on incompatible data communications protocols. A second action would be for DCA and JTC3A to develop a detailed, long-range plan to focus U.S. initiatives for enhancing civil standards for open systems interconnection for tactical use. Such a plan would extend the current work on developing supplements to GOSIP and the Services' plans to transition to GOSIP.

Summary

POTENTIAL COURSES OF ACTION FOR OSD

- **OUSD(A)/TWP/LW AND ASD(C3I)-T&TC3 COULD:**
  - **(1) Support Service initiatives to develop**
    - Multi-Service AFATDS
    - Multi-Service MCS
    - Capabilities to exploit battlefield air picture
  - **(2) Request Service briefings on efforts to use common standards, hardware, and software for ADP C2 support**
  - **(3) Request that DCA/JTC3A:**
    - Ensure Army and Marine Corps complete work quickly on Joint information exchange standard for AFATDS
    - Develop a detailed plan to focus U.S. initiatives to enhance civil standards for OSI for tactical use

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APPENDIX A

COMBINED ARMY AND MARINE CORPS REQUIREMENTS FOR MANEUVER CONTROL

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COMBINED ARMY AND MARINE CORPS REQUIREMENTS FOR MANEUVER CONTROL

A. FUNCTIONAL CHARACTERISTICS

1. Information Processing

a. Message Handling

(1) Possess capability to compose, edit, transmit, receive, store, retrieve, and relay messages and free text, by priority, with fielded and planned systems (FM[1]); to edit, compose, and validate messages. (MCS[2])

(2) Provide a manual review capability to display an incoming message and allow the operator to delete, change, or forward the message. (FM)

(3) Provide an automatic relay and message routing capability, programmable by the operator (FM); distribute information to multiple addressees and locations using single or multiple communications means in a single keyboard operation. (MCS)

(4) Be capable of identifying the source of any message received. (FM)

(5) Provide printed copy of any message, screen, display, and file. (FM)

(6) Be capable of being manually programmed for multiple sets of message authenticators. (FM--desired, MCS)

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1 *Draft FIREMAN ROC*, MCCDC, April 1989.

2 *MCS ROC*, Annex D to the ATCCIS ROC, HQDA, September 1989.

(7) Be capable of self-authentication of received or transmitted messages and resynchronization of message authenticators with other workstations. (FM)

b. Other Information Processing

(1) Collect, manipulate, distribute, process, display, and store information. (TCO,[3] ATCCS,[4] MCS)

(2) Provide for storage, initialization, selective retrieval, and selective purging of information. (MCS)

(3) Transmit and receive data necessary to create two- and three-dimensional displays. (MCS)

(4) Store and transmit decision graphics and operational graphics. (ATCCS)

(5) Receive, transmit, store, display, and edit tactical plans and orders, including supporting overlays and fragmentary supplements. (FM, TCO-86[5])

c. Interaction with Database

(1) Provide a common-user database with automatic update across the affected network. (FM, ATCCS)

(a) To ensure[6] common perception of the battlefield. (FM)

(b) Capable of tracking status of at least 150 discrete types of resource items and storing a minimum of 250 unit locations. (FM)

(c) Capable of simultaneous[6] receipt and storage of data from all subscribers and access on demand without degradation of system performance. (FM)

(d) Capable of selectively controlling access to, or modification of, the database. (ATCCS)

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3 *ROC for a Tactical Combat Operations (TCO) System,* ROC No. CCC 1.31, HQMC, 7 August 1978.

4 *Family of ATCCS ROC,* HQDA, December 1986.

5 Not contained in the original, approved TCO ROC, but identified in the *Proposed Revised Draft TCO ROC,* HQMC, 4 November 1986.

6 These requirements are included for completeness, but appear to be goals for development but not requirements that could, in fact, be achieved and operationally tested.

(2) Possess capability to initiate, edit, transmit, receive, store, retrieve, and relay messages and free text from the database. (ATCCS, MCS)

(3) Be capable of drawing data from FIREFLEX database on demand to include fire support asset locations and fire support coordination measures. (FM)

d. Interoperability

(1) **Marine Corps**:

(a) Interoperate with planned and fielded digital C2 systems. (TCO, FM)

(b) Support MTS broadcast and switch protocols for USMC interoperability. (FM, TCO-86)

(c) Interface to FIREFLEX, DCT, FMF EUCE, and PLRS.[7] (FM)

(d) Interoperate with MAGIS, MACCS, PLRS, MIPS, and MILOGS. (TCO)

(e) Interoperate with ATACC,[8] TAOM, and DASC. (TCO-86)

(f) Interoperate over wire, tactical radio, COMSEC equipment, and other planned communications systems. (FM)

(2) **Army**:

(a) Interoperate with battlefield functional area (BFA) subordinate systems to receive and transmit reports and assigned tasks. (ATCCS)

(b) Implement ATCCS and BFA-unique interoperability requirements. (ATCCS, MCS)

(c) Exchange information as specified in the User Interface Requirements (UIR) documents. (MCS)

(d) Provide interoperability with other BFAs. (ATCCS, MCS)

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7 Automated interface with PLRS is identified in the Draft FIREMAN ROC as P3I.

8 Automated interface with ATACC is identified in the Draft FIREMAN ROC as P3I.

(3) **Joint and Combined.**

(a) Interoperate with Joint and Combined automated systems in compliance with U.S. Message Test Formats (MTFs) (JINTACCS) program and STANAGs. (ATCCS, MCS)

(b) Interoperate with MCS, FLCS, and all other NATO armed forces' C2 systems. (FM)

(c) Exchange information with C2 centers of other Services and countries as required by JINTACCS. (TCO)

(d) Be capable of adopting (P3I) Joint standards[9] to be published for the Variable Message Format Technical Interface Design Plan (TIDP). (FM, TCO-86)

(4) **General.** Provide for P3I evolution to automated interoperability gateways. (FM)

2. Decision Support

a. Unit Status and Tactical Situation

(1) From the database provide an operational portrayal of the battlefield, depicting as graphics the current tactical situation of a force. (FM, MCS)

(a) Graphical display of the tactical situation supports mission accomplishment. (FM)

(b) Provides two- and three-dimensional displays in color or monotone. (MCS)

(c) Create, display, store, manipulate, and print (at the same scale viewed) standard military symbology and decision graphics. (MCS)

(d) Map includes the area of operations with associated battlefield geometry and control measures.

(e) Map includes overlays capable of showing status and activity as required from current Commander's Critical Information Requirements (CCIRs) and Critical Elements of Information (CEIs[10]). (MCS, FM)

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9 Sometimes referred to as the K-Series JINTACCS messages, these are now under development by the Army and the Marine Corps with a specific message set for Joint interoperability of fire support C2 systems (initially, the multi-Service AFATDS).

10 Defined in OH 6-1A, *Ground Combat Element Command and Control*, HQMC.

(f) Map display permits the user to vary the scale, "window" around the area of operations.

(g) Map provides capability to declutter at the discretion of the user. (MCS)

(h) Tactical information can be displayed on large-screen displays to assist planning and briefing functions. (FM)

(2) Provides user-specified reports and displays. (FM)

(a) Provides unit status reports displayed on command. (FM)

(b) Provides flexible format adaptable to a particular Commander's desires. (FM)

(c) May be based on ad hoc queries. (FM)

(3) Display position location information received from PLRS. (FM)

b. Planning and Coordination

(1) Enhance planning with automated analytic support. (ATCCS)

(2) Provide Commanders and staffs the ability to plan future operations and analyze the alternative courses of action. (MCS)

(3) Provide the capability to rapidly prepare and disseminate hard copies of tactical plans and orders with supporting overlays. (FM)

c. Desired Characteristics for Preplanned Product Improvements (P3I)

(1) Provide for P3I evolution to intelligence preparation of the battlefield (IPB), to include opposing force templates, terrain modeling, and climatic/trafficability templates. (FM)

(2) Provide for P3I evolution for using artificial intelligence with IPB. (FM)

(3) Provide for P3I evolution for automating interoperability gateways. (FM)

3. Data Management

(1) Capable of computing grid coordinates resected using bearing and distance from one or from two known points and converting latitude and longitude data to grid coordinates. (FM)

(2) Exchange standard data elements in standard formats with other BFA control systems. (ATCCS)

(3) Manage system data. (MCS)

(4) Capable of dumping data to tape or hard disk. (FM)

4. Communications

(1) Capable of simultaneously receiving and transmitting over multiple communications means. (FM, MCS)

(a) By priority. (MCS)

(b) In a single keyboard operation. (MCS)

(c) With a subscriber table and net selection through keyboard or touch panel input. (FM)

(d) Sensing a net busy condition for digital voice or data traffic, as well as analog traffic. (FM)

(e) Automatically transmitting when net is clear after an appropriate software-settable delay. (FM)

(2) Provide interface to standard tactical communications. Equipment shall include, but not be limited to:

(a) **Marine Corps** (FM):

- PRC-77 and VRC-12 family of radios and SINCGARS
- HF and UHF radios
- Unit-level Tactical Data Switch (ULTDS) and Unit Level Circuit Switch (ULCS)
- Wire
- COMSEC equipment.

(b) **Army** (ATCCS, MCS):

- VCR-12-series radios and SINCGARS
- Wire (WD-1TT, WD-36TT, WF-16)
- KY 57/58, KY-68, KG-84, and DNVT-V2 COMSEC equipment
- PLRS/JTIDS
- IHFR, SCOTT, and TD-1065.

(3) Have a headset/handset connection that will allow the operator to communicate using voice. Use of this function must not cause any loss of digital information that resides in, enters, or departs the equipment. (FM)

(4) Provide sufficient communications ports to support standard external and internal operational requirements. (FM)

(5) Provide a local area network (LAN) capability. (MCS)

(6) Provide P3I evolution to:

(a) Automated interface to PLRS and ATACC. (FM)

(b) Automated interface to automated intelligence, logistics, and personnel systems. (FM)

(c) Video conferencing. (FM)

5. System Management

a. Synchronization

(1) Be capable of automatic time synchronization from a designated internal or external source (e.g., another system, such as FIREFLEX, PLRS, GPS). (FM)

b. Security

(1) Meet TEMPEST requirements. (FM, MCS)

(a) With physical security as primary means of protection. (MCS)

(b) With no unique electromagnetic signature where introduced. (MCS)

(c) Exclusive of data transmission and to the degree possible for NDI devices, creates no unique signature. (FM, MCS)

(2) Be capable of operating in an electromagnetic warfare (EW) environment with minimal degradation. (FM, MCS)

(3) Receive, store, retrieve, transmit, and print data ranging from UNCLASSIFIED through SECRET with classification markings. (ATCCS, MCS)

(4) Allow automatic transmission of SECRET data to selected users. (ATCCS)

(5) Be capable of loading new software and purging classified information in the field. (MCS)

(6) Operate at SECRET level and within service security regulations. (FM, MCS) TOP SECRET desired. (TCO)

(7) Provide ECCM design to reduce effects of radio electronic combat (REC) threat and vulnerability to ECM. (FM, MCS)

c. Continuity of Operations (CONOPS)

(1) Provide for continuity of operations. (ATCCS, MCS) Support unit echeloning, operate in a degraded mode, provide data redundancy at remote sites. (TCO-86)

(2) Provide graceful degradation of capabilities. (ATCCS)

(3) Allow for system reconfiguration. (MCS)

(4) Provide capability to discontinue message processing and flow of information items by precedence. (MCS)

(5) When loads exceed peak, enable lower priority data to be held at originating device until load decreases. (MCS)

6. Human-Machine Interface

a. Alerts

(1) Provide visual and audible signals to alert the operator (e.g., for an incoming message). (FM, ATCCS, MCS)

(2) Allow operator to distinguish between a "routine" and "urgent" priority. (FM)

(3) Allow operator to mute the audible signal when necessary. (FM)

(4) Support manual input of information. (ATCCS)

(5) Alert users when storage capacity is approaching its limit. (MCS)

(6) Minimize mnemonics. (TCO)

(7) Provide a clock display upon command. (FM)

b. Symbols

(1) Manual over-ride and automatic flagging of incorrect entries to the system is desired. (FM)

(2) Generate operational symbols and decision graphics from database entries in accordance with FM 101-5-1. (ATCCS)

c. Formats and Lighting

(1) Format data presented to the user and notify user of invalid entries. (MCS)

(2) Provide visual indicators and messages easily readable in all ambient light conditions. (MCS)

d. Technology

(1) Provide ability to input data through a touch panel or comparable device, as well as from a keyboard. (FM)

(2) Provide for P3I evolution to full color graphics and digitized map displays. (FM)

(3) Provide for P3I evolution to support voice recognition. (FM)

7. Embedded Training

(1) Possess an embedded training capability. (FM, MCS) Supports training by generating simulated inputs and providing realistic feedback for operator interactions. (TCO)

8. System Support and Software Portability

(1) Provide capability for expansion and design flexibility to accommodate additional C2 applications. (MCS)

(2) Possess a design in data extraction and data reduction capability to allow isolation of software faults. (ATCCS, FM)

(3) Possess self-test capability to isolate failures. (FM, ATCCS)

(a) With built-in test (BIT), built-in test equipment (BITE), operator diagnostics, and other means for accurate fault detection. (ATCCS)

(b) With a 0.95 probability of isolating faults detected to the lowest replaceable module. (FM)

(c) Will have a maximum of 0.03 probability of false BITE indicators. (FM)

(4) Support portability of BFA-unique and other software written in Ada. (ATCCS)

B. PHYSICAL CHARACTERISTICS

1. Power

(1) Be capable of operating from normal military power supplies. Retain all stored database information in either a POWER ON or OFF mode. (FM, MCS)

(2) Be capable of 24-hour continuous operation on batteries. Be capable of retaining stored information during battery changeover. (FM)

(3) Provide uninterruptable power to support archiving of data, with 100% memory retention for at least 5 minutes during loss or fluctuation of external power. (ATCCS, MCS)

2. Operability

(1) Be capable of being operated from all standard and Service-unique vehicles, ships, and aircraft. Operate in a stand-alone mode. (FM) Operate on the move. (MCS)

(2) Be operable by military wearing NBC equipment, up to and including MOPP IV, and cold weather clothing appropriate for arctic conditions. (FM, MCS)

(3) Facilitate standard equipment camouflage. (ATCCS)

(4) Be capable of setup and teardown by a single person. (FM)

(5) The system configuration at each echelon will be consistent with the degree of mobility required by the using unit during amphibious operations and operations ashore. (FM)

3. Transportability

(1) Be capable of being transported in all standard and Service-unique vehicles, ships, and aircraft at expected speeds. (FM, MCS) Transportable by air/sea/rail and standard military wheeled vehicles when appropriately packaged. (ATCCS)

(2) Be transportable in tactical military/amphibious vehicles on and off roads and through surf at tactical speeds with no detrimental effects by the using unit during amphibious operations and subsequent operations ashore. (FM)

(3) Transportability of NDI devices in tracked vehicles is desired but not required. (MCS)

4. Size and Weight

(1) No single component violates size and weight limits for one-person carry rule. (FM) Weighs no more than 50 lb. (TCO)

5. Environmental Characteristics

(1) Be operable in all combat and environmental conditions to include, but not limited to, smoke, dust, rain, fog, NBC, salt water, or any combination of these conditions. (FM)

(2) Required operating temperature range is -25 deg F to 125 deg F. (FM)

(3) Full militarization may not be required if sufficient ruggedization can be demonstrated to meet criteria developed separately. (FM)

(4) Nuclear survivability (electromagnetic pulse and radiation) is desired, but not required. (FM, TCO, MCS--TCT only)

(5) Survive blast and fragmentation at least as well as personnel who operate the system and other equipment. (MCS)

(6) Operable in a chemically contaminated environment. (FM, MCS)

(a) Be constructed of materials resistant to chemical agents and chemical agent decontaminants to the maximum extent possible. (FM)

(b) Be painted with chemical resistant paint. (FM)

(c) Ability to withstand corrosive decontamination not required. (MCS)

(7) Meet Service environmental standards. (FM, MCS)

(8) NDI devices be operable in sheltered facilities without environmental conditioning where temperatures range 40-95 deg F and humidities range 10-80 percent. (MCS)

6. Nondevelopmental Items (NDI)

(1) Use NDI wherever possible. (FM) Use TCP, AC, and ATCCS CHS. (MCS)

(2) Use standard Service components and subassemblies where possible. (FM)

7. Testability

(1) Have printed circuit boards and modules designed to ensure testability utilizing standard military test equipment. (FM)

8. Support Equipment

(1) Does not require peculiar support equipment or special tools other than those presently found or planned at electronic maintenance facilities. (ATCCS, MCS, FM)

APPENDIX B

CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL

Maneuver Control Assessment

CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL

- **INFORMATION PROCESSING**
  - Provide a common-user database system with automatic update--capable of receiving, transmitting, editing, storing, and displaying information in printed copy, graphics, and overlays
  - Provide a capability to track the status of 150 types of resource items, store a minimum of 250 unit locations, and permit access to user-specified information based on ad hoc queries
  - Support automated cross-functional information exchange
  - Support Joint interoperability and provide growth for Combined interoperability
- **DECISION SUPPORT**
  - Provide an operational portrayal of the battlefield, depicting as a battlefield graphic the current tactical situation of a force with associated battlefield geometry and control measures
  - Provide overlays and reports capable of showing resource status and activity in areas covered by CCIRs--system must permit user to vary map scale, move (window) around area of operations, and declutter map

RPW 11-22-89-5a

Maneuver Control Assessment

CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL (Cont'd)

- **COMMUNICATIONS**
  - Provide capability to receive, store, and transmit, by priority, over multiple communications means, and provide a headset/handset connection that will allow voice communications without loss of digital information
  - Provide capability to interoperate over wire, radio, and COMSEC equipment and possess sufficient communications ports to support peripherals and data transfer with planned and fielded, Joint and Combined automated C2 systems
  - Provide system capability to:
    - Identify source of any message
    - Sense a net busy condition
    - Access system on demand
    - Program automatic message routing
    - Program and resynchronize message authenticators
    - Detect visually and audibly incoming traffic, by priority

RPW 11-22-89-5b

Maneuver Control Assessment

CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL (Cont'd)

- **SYSTEM MANAGEMENT**
  - Provide a clock display upon command and be capable of automatic time synchronization
  - Meet TEMPEST requirements
  - Provide selective control of the database and entries to the system
  - Operate in an EW environment with minimum degradation
  - Provide for continuity of operations and graceful degradation of capabilities
  - Provide a self-test capability to isolate failures
  - Operate at SECRET level and within standard security regulations

RPW 11-22-89-5c

Maneuver Control Assessment

CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL (Cont'd)

- **PHYSICAL CHARACTERISTICS**
  - Be capable of operating from standard military vehicles or in a stand-alone location–operating with generator or vehicle power supplies, operating continuously on internal batteries, and retaining stored data in a power ON or OFF mode
  - Be operable by individuals wearing NBC or cold-weather clothing
  - Be operable in all combat/environmental conditions
  - Be of a size and weight so that no single component violates the "one-man carry" rule
  - Have visual indicators and messages readable in all ambient conditions
  - Use standard components and sub-assemblies when possible
  - Not require peculiar support/test equipment or tools
  - Be constructed of materials resistant to chemical agents and their decontaminants to the maximum extent possible--be painted with chemical-resistant paint and facilitate standard equipment camouflage
  - Possess an embedded training capability
  - Be nuclear survivable
  - Comply with human engineering design criteria

RPW 11-22-89-5d

APPENDIX C

ARMY TACTICAL COMMAND AND CONTROL SYSTEM (ATCCS)

System Concept Assessment

STATUS OF REQUIREMENTS--ARMY

Area	System	Date	Status	Document	Reference
System-Level	ATCCS	Dec 86 Dec 86 Dec 86 Jun 89	Final Final Final Final	ROC O&O Plan CHS ROC TEMP	N/A Annex B to ATCCS ROC Annex C to ATCCS ROC Revision 2, Change 4
Mvr Ctrl	MCS	Sep 89 Sep 89	Final Final	Revised ROC Evolutionary Dev., Block Approach	Annex D to ATCCS ROC Annex A to MCS ROC
Fire Support	AFATDS	Jan 89	Final	ROC	Annex E to ATCCS ROC (dated 14 May 1987)
Air Defense	FAAD C2I	Oct 89	Final	ROC	Annex F to ATCCS ROC
Intel/EW	ASAS	Dec 86	Final	ROC	Annex G to ATCCS ROC
CSS	CSSCS	Aug 88	Final	ROC	Annex H to ATCCS ROC

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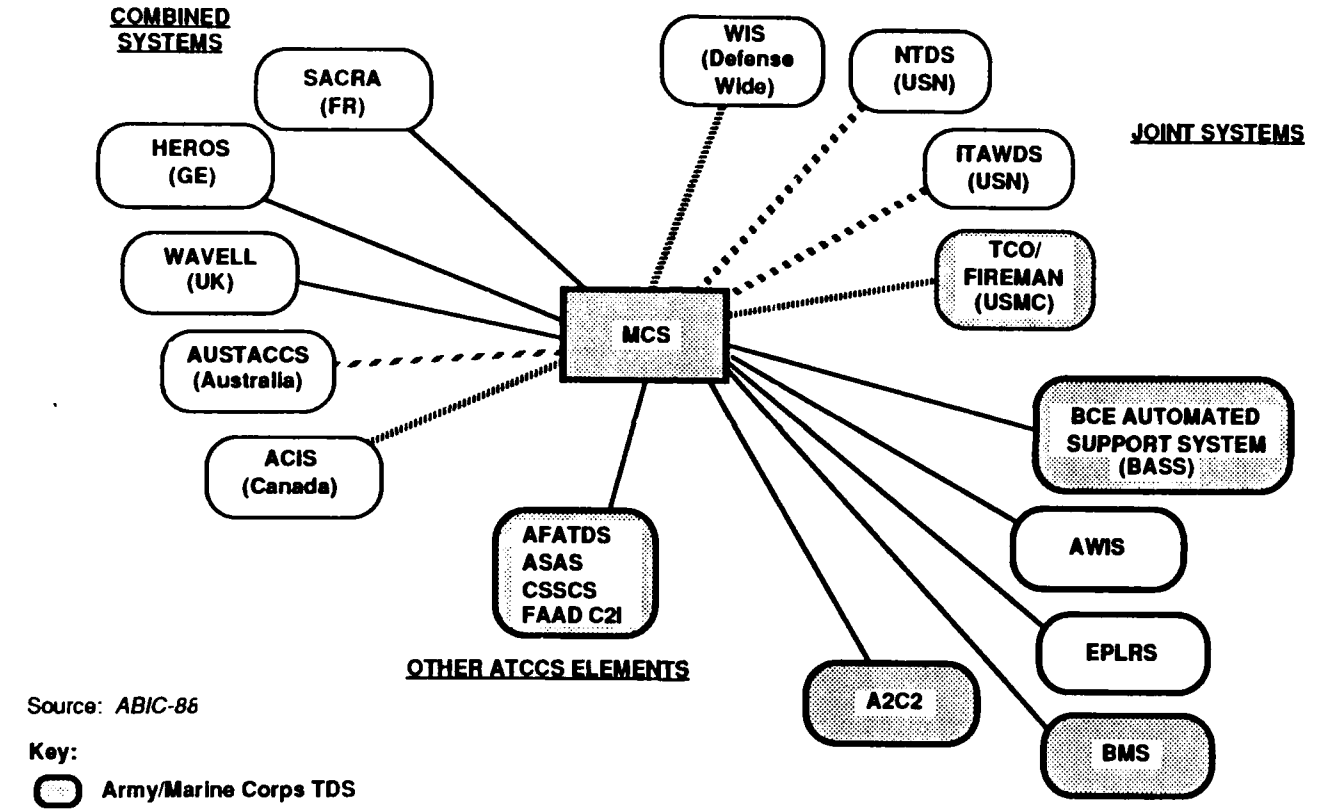
System Concept Assessment

ARMY MANEUVER CONTROL SYSTEM INTERFACES



Source: *ABIC-86*

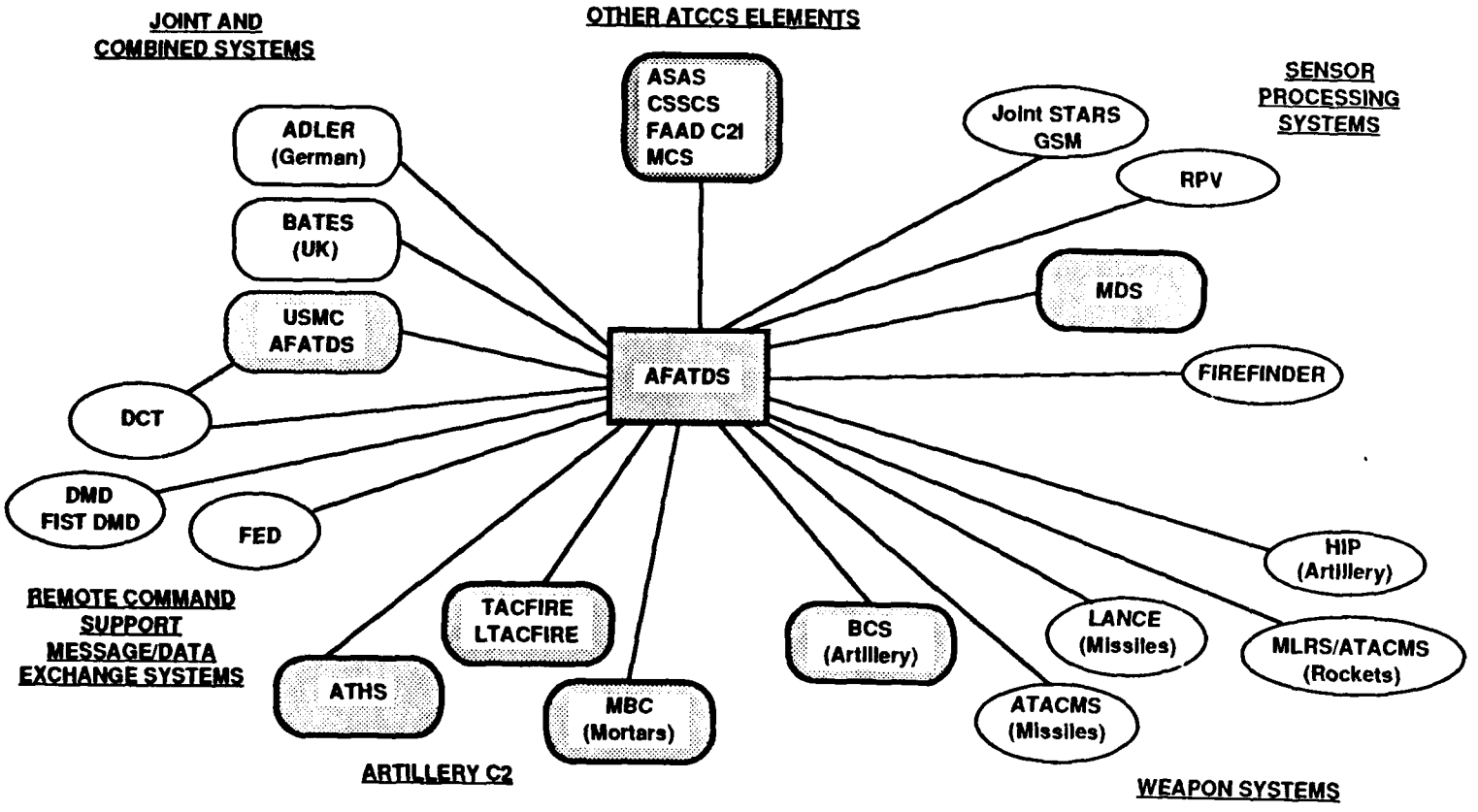
Key:

- Army/Marine Corps TDS
- Automated Interface
- Manual Interface (data is to be physically moved via compatible electronic medium)
- Remote Interface (data is to be rekeyed to a data entry device)

RPW-10-20-89-9B

System Concept Assessment

ARMY FIRE SUPPORT SYSTEM INTERFACES



Sources: *ABIC-88; Army/USMC MOA* (Aug 89)

Key: ◯ **Army/Marine Corps TDS**

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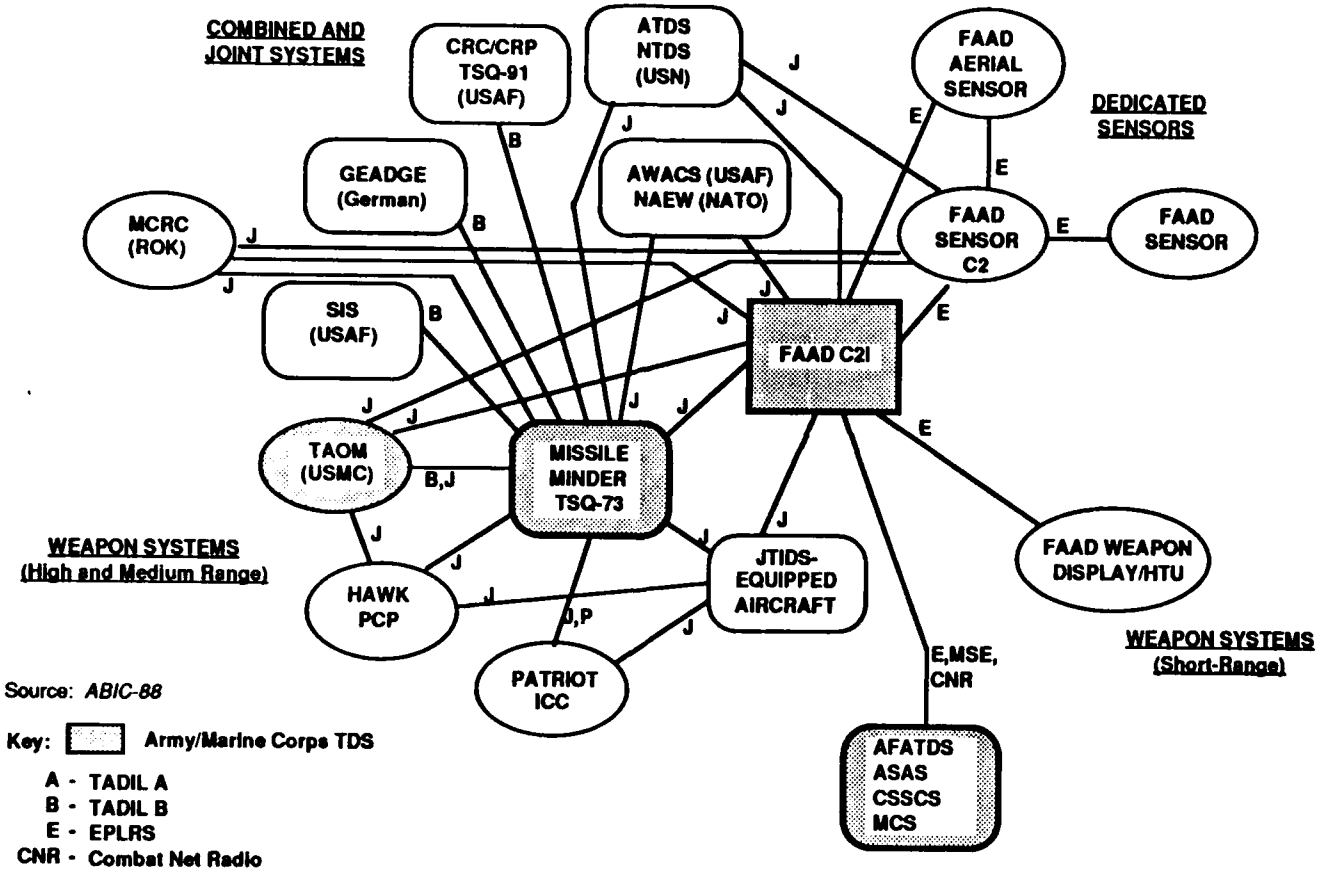
System Concept Assessment

ARMY AIR DEFENSE SYSTEMS AND INTERFACES



Source: *ABIC-88*

Key: Army/Marine Corps TDS

- A - TADIL A
- B - TADIL B
- E - EPLRS
- CNR - Combat Net Radio
- MSE - Mobile Subscriber Equipment
- J - JTIDS
- P - ATDL-1

RPW -10-20-89-9C

System Concept Assessment

OBSERVATIONS ON ADP SUPPORT OF ARMY C2

- INVESTMENT IN FIVE NEW C2 SYSTEMS FOR ATCCS IN 1990s WILL BE EXPENSIVE ($5-10 B)
- DEVELOPMENT STRATEGY IS, FOR THE MOST PART, BASED ON PRINCIPLES NEEDED TO ENSURE FIELDING OF MODERN TACTICAL DATA SYSTEMS
  - Developing modular software first (using surrogate hardware, Ada)
  - Postponing selection of hardware as long as possible
  - Using common standards and common components where possible
  - Reexamining need for militarization specifications
  - Fielding of NDI hardware where possible
- AFATDS COULD BE DEVELOPED TO SATISFY REQUIREMENTS OF BOTH ARMY AND MARINE CORPS
- MCS VERSION 11 WILL HAVE A SIGNIFICANT FORCE-LEVEL CONTROL CAPABILITY BUT WILL NOT INTEROPERATE SATISFACTORILY WITH THE CONTROL SYSTEMS OF OTHER FUNCTIONAL AREAS
- FAAD C3I DEPENDS HEAVILY ON ADVANCED COMMUNICATIONS (EPLRS, JTIDS) AND NEW SENSORS NOT YET FIELDED

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APPENDIX D

MARINE TACTICAL COMMAND AND CONTROL SYSTEM (MATCCS)

System Concept Assessment

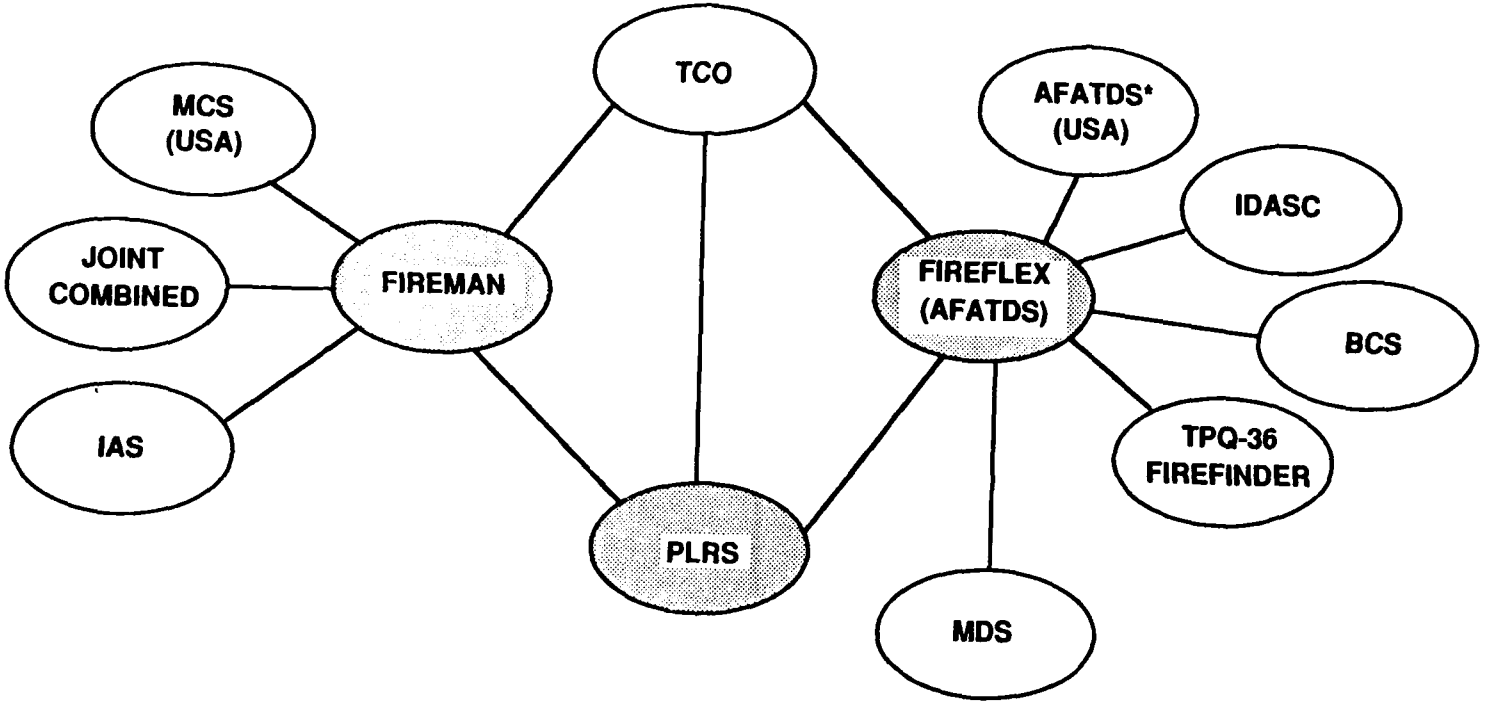
STATUS OF REQUIREMENTS--MARINE CORPS

Area	System	Date	Status	Document Type	Originator
System	MTACCS	Nov 89	Draft	Concept Paper	PM GRND/CSS C2
MAGTF C2	TCO	Aug 78	Final	ROC	HQMC
GRND C2	FIREMAN	Apr 89	Draft	ROC	MCCDC
	FIREFLEX	Apr 89	Final	ROC	MCCDC/HQMC
	PLRS	Sep 76	Final	JSOR	HQMC/HQDA
AVN C2	ATACCS	Jun 85	Final	ROC	HQMC
	TAOM	Feb 87	Final	Revised ROC	HQMC
	IDASC	Aug 84	Final	ROC (Draft Revision Jul 89)	HQMC
	MATCALS	Jul 73	Final	SOR	
CSS C2	MIPS	?			
	MILOGS	?			
	IFASC	?			
INTEL C2	IAS	Jun 75	Final	SOR (MAGIS-IAC Segment)	HQMC
	TERPES	Dec 76	Final	CMC Directive (TSQ-90)	HQMC
	JSIPS	Jun 82	Final	ROC (ASIP)	
	TCAC	Mar 83	Final	ROC (ISIS)	
AMPHIB WARFARE C2	ITAWDS	?			U.S. NAVY
	TFCC	?			U.S. NAVY
	FDDS	?			U.S. NAVY
	SMRAALS	Dec 71	Final	Navy SOR (MRAALS)	U.S. NAVY

RPW 11-22-89-2

System Concept Assessment

GROUND C2 SUBSYSTEMS AND INTERFACES



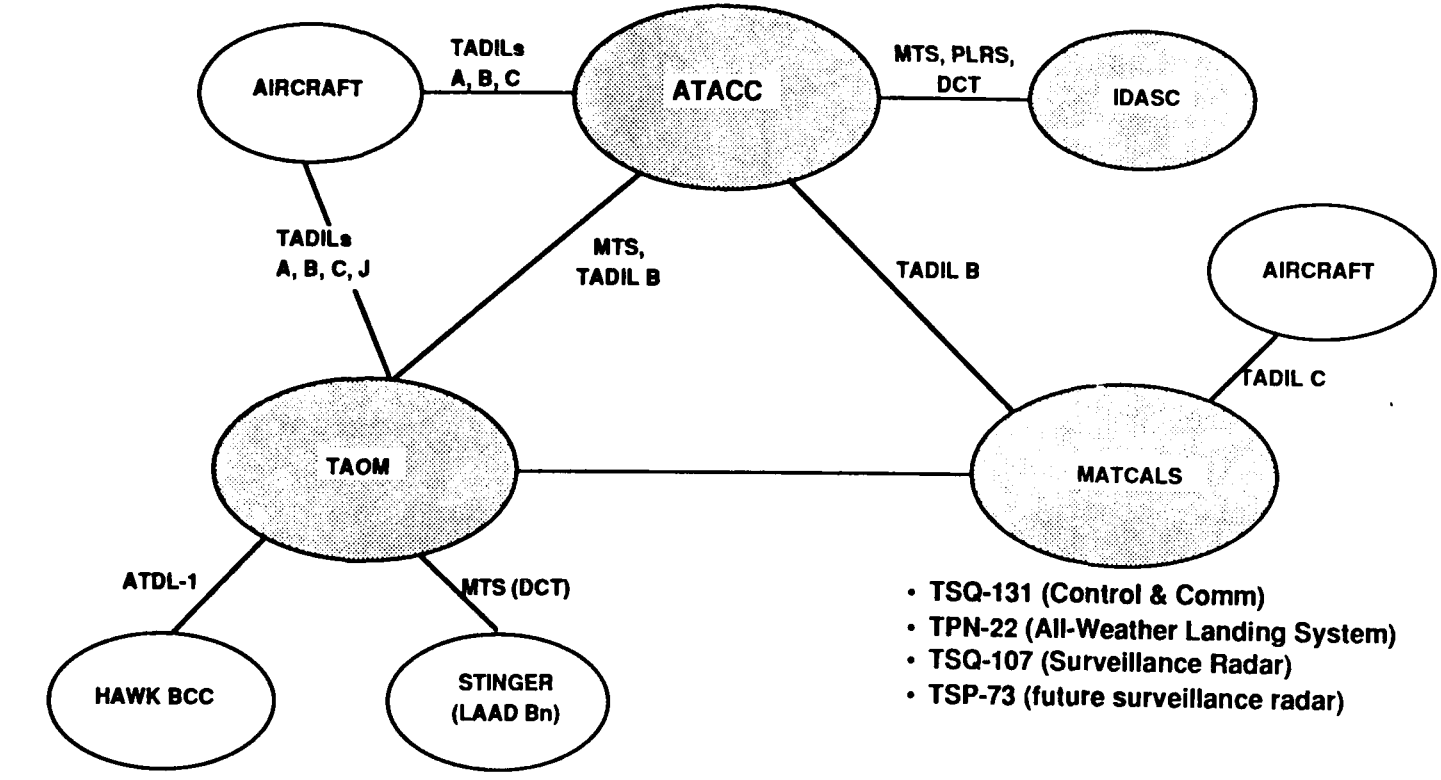
Key: MTACCS Ground C2 Subsystem

*Note: USMC and USA have an MOU and are actively working together on a multi-Service version of AFATDS to meet both Services' ADP support requirements for Fire Support C2.

RW-11/21/89-3

System Concept Assessment

MARINE AIR COMMAND AND CONTROL SYSTEM (MACCS) SUBSYSTEMS AND INTERFACES



Key: ⬭ MACCS Subsystem

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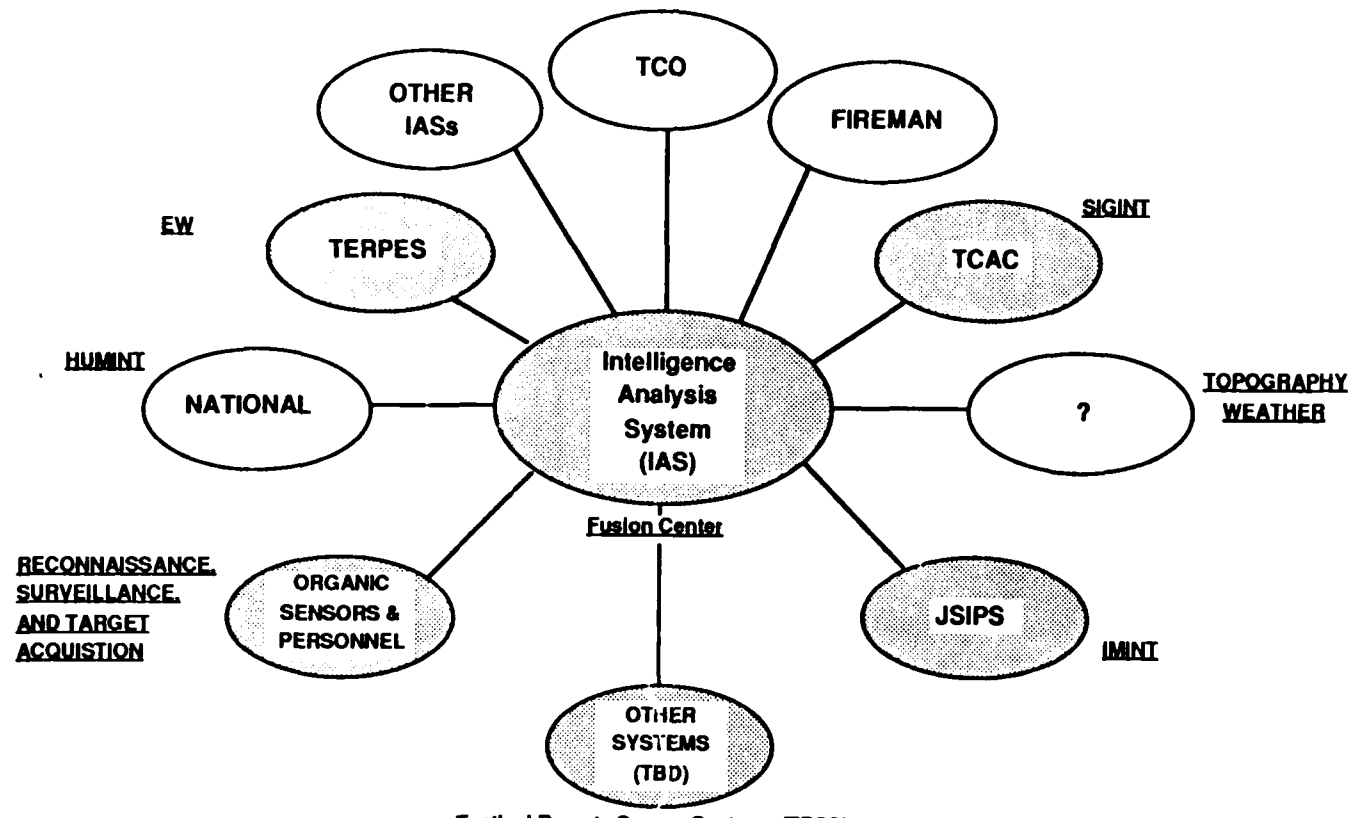
System Concept Assessment

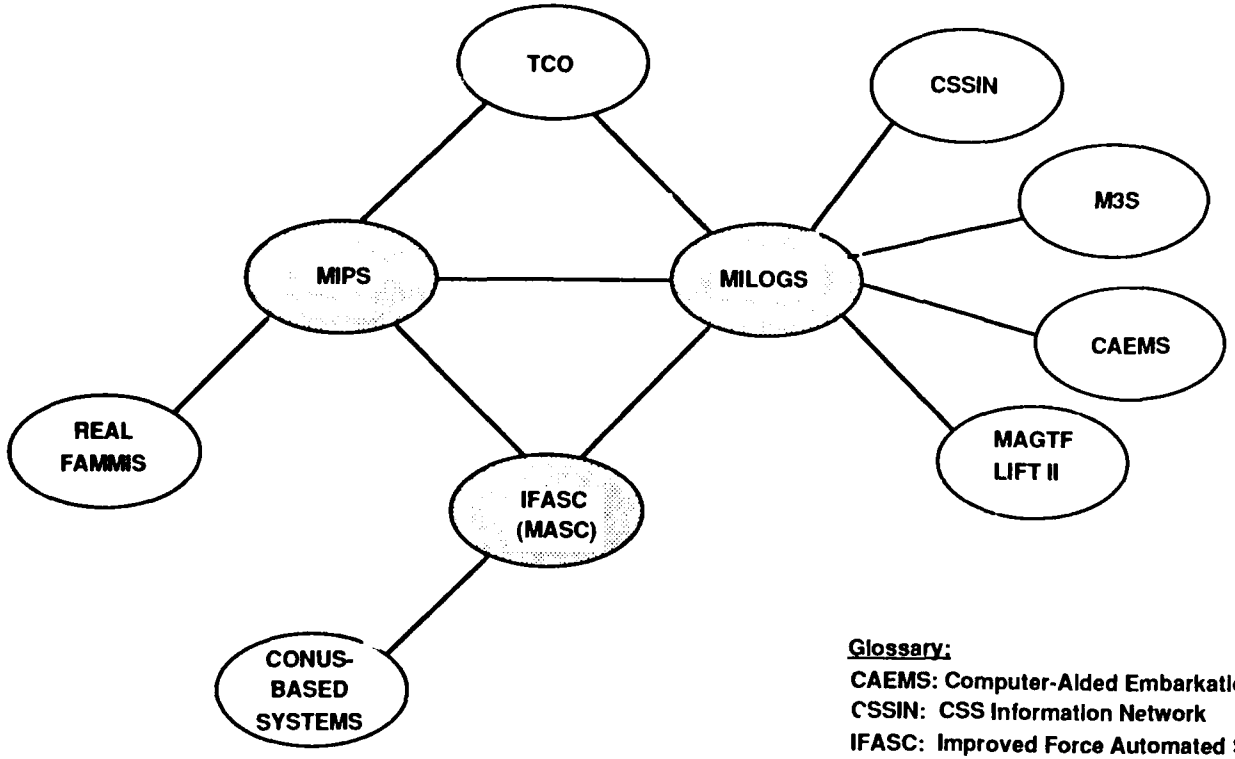
MARINE AIR-GROUND INTELLIGENCE SYSTEM (MAGIS) SUBSYSTEMS AND INTERFACES



RW-11/21/89-5

System Concept Assessment

MTACCS CSS C2 SUBSYSTEMS AND INTERFACES



Key: ⬭ MTACCS CSS C2 Subsystem

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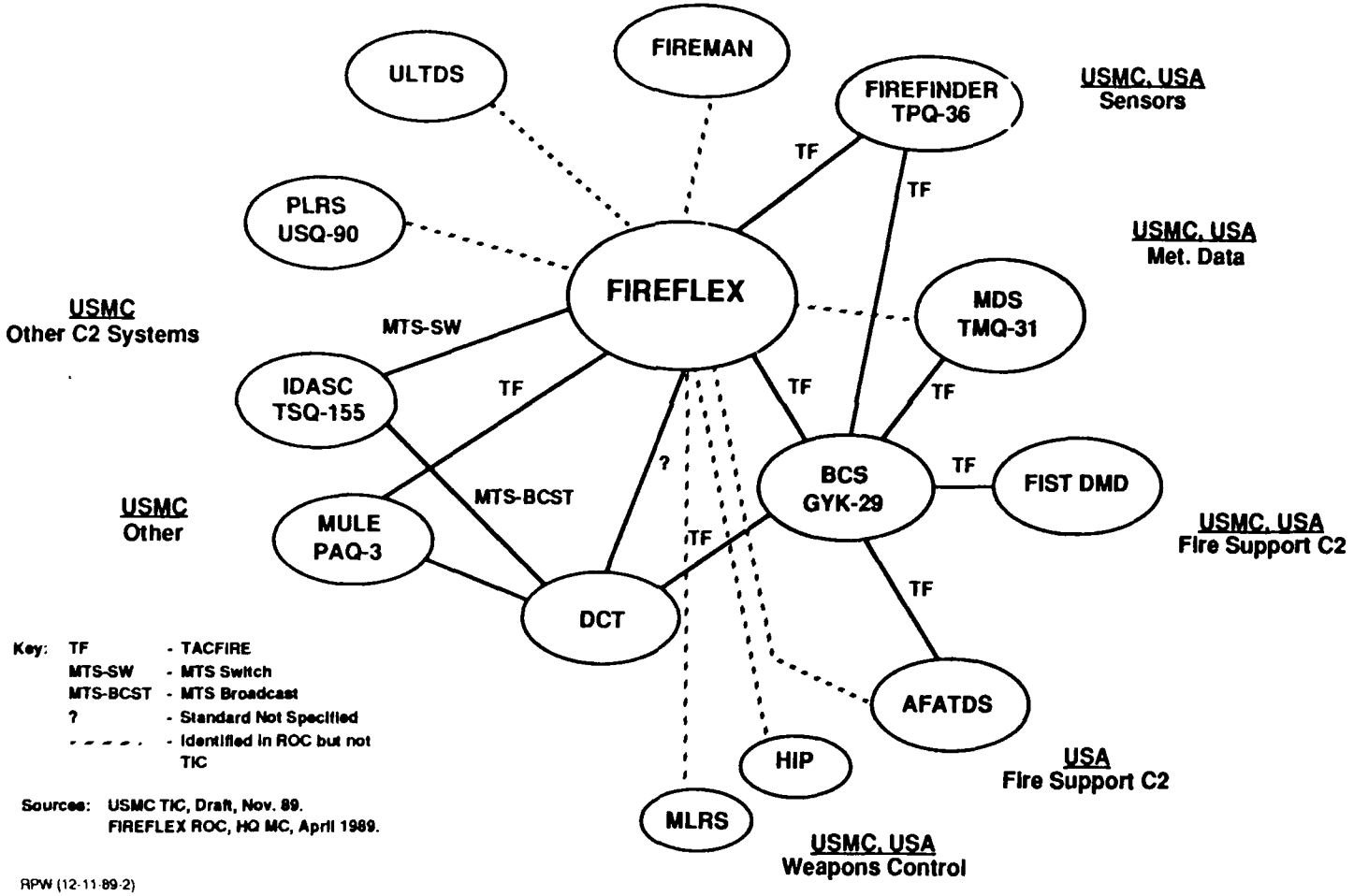
Glossary:

CAEMS: Computer-Aided Embarkation System
CSSIN: CSS Information Network
IFASC: Improved Force Automated Services Center
MASC: MAGTF Auotmated Services Center (P3I)
M3S: Marine Corps Standard Supply System
MILOGS: Marine Integrated Logistics System
MIPS: Marine Integrated Personnel System
REAL FAMMIS: Real-time Finance and Manpower Management Information System

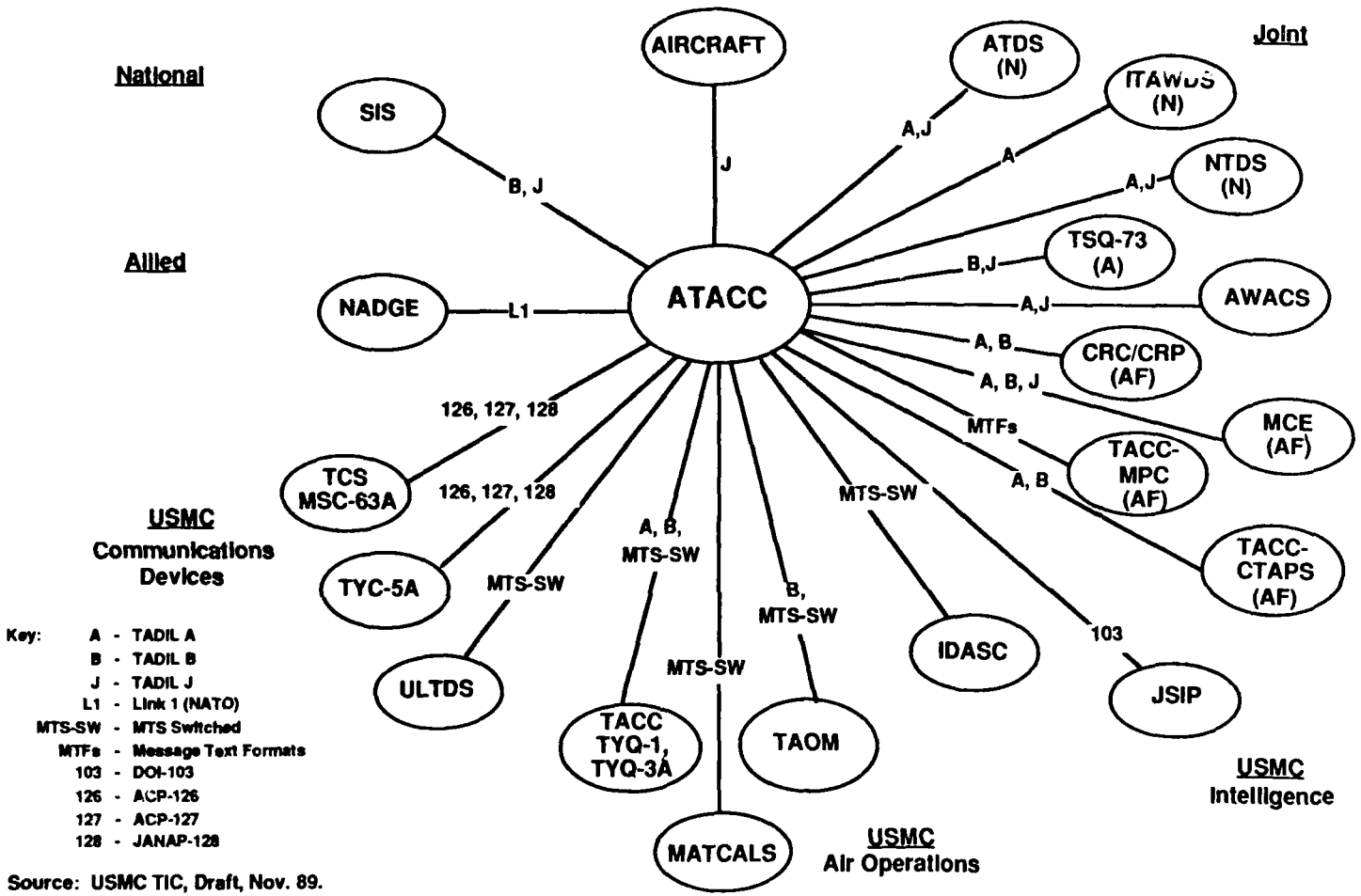
Fire Support Assessment

REQUIRED INTERFACES FOR FIREFLEX



Air Operations Assessment

INTERFACE REQUIREMENTS FOR ATACC



Key:
- A - TADIL A
- B - TADIL B
- J - TADIL J
- L1 - Link 1 (NATO)
- MTS-SW - MTS Switched
- MTFs - Message Text Formats
- 103 - DOI-103
- 126 - ACP-126
- 127 - ACP-127
- 128 - JANAP-128

Source: USMC TIC, Draft, Nov. 89.

RPW (12-11-89-1)

System Concept Assessment

OBSERVATIONS ON ADP SUPPORT OF USMC C2

- NEED TO COMPLETE ONGOING WORK TO REDEFINE MTACCS SYSTEM OF SYSTEMS CONCEPT TO ENSURE FIELDED TDSs WORK EFFECTIVELY TOGETHER
  - Technical interface concept (TIC) is mature and a major step
  - Revision of C2 Master Plan is needed
  - User information exchange requirements (IERs) need to be specified
- NEED DETAILED USER SPECIFICATION IN EACH FUNCTIONAL AREA OF THE FUNCTIONS, SUBFUNCTIONS, AND TASKS IN A FORM THAT CAN BE USED AS THE BASIS FOR ADP SUPPORT REQUIREMENTS; THESE MIGHT INCLUDE:
  - Type and degree of automation for each task
  - Marine Corps version of Army's "Red Book" (for FIREFLEX)
  - Marine Corps version of Army's MCS Design Consideration Memorandum (for FIREMAN)
- NEED TO SPECIFY CAS/NGF SUPPORT REQUIREMENTS BY END OF FY90 TO BE INCLUDED IN AFATDS BLOCK 2
- NEED TO REVIEW TIC TO ENSURE JOINT AND COMBINED IERs ARE PROPERLY SUPPORTED AT EVERY APPROPRIATE ECHELON AND C2IE ELEMENT AND ARE CONSISTENT WITH FUNCTIONAL INTEROPERABILITY ARCHITECTURES (FIAs)
- SHOULD IDENTIFY (e.g., MCTCA) COMMUNICATIONS MEANS TO BE USED NOW AND IN THE FUTURE TO SUPPORT JOINT AND COMBINED NEED LINES (e.g., RADIOS, SWITCHES, LOCAL AREA NETWORKS)

RPW-10-20-89-7

APPENDIX E

ADDITIONAL INFORMATION

BACKGROUND

- CONGRESSIONAL AND OSD INTEREST IN DEVELOPMENT OF MIFASS AND AFATDS (1986 TO PRESENT)
- OSD INTEREST IN HOW MARINE CORPS FIRE SUPPORT REQUIREMENTS COULD BE MET FOLLOWING THE TERMINATION OF MIFASS
- CONTINUED CONGRESSIONAL AND OSD INTEREST IN WHETHER INVESTMENTS BY ONE SERVICE CAN BE EXPLOITED FURTHER BY ANOTHER SERVICE
- CURRENT TASKING IS FOCUSED ON ASPECTS OF AIR SUPPORT (AIRSPACE CONTROL), MANEUVER CONTROL, FIRE SUPPORT, AND INTEROPERABILITY

RPW-10-20-89-4

SELECTED IDA TASKING (1989)

- ASSESSMENT OF SUBSYSTEM COMMONALITY FOR SELECTED ARMY AND MARINE CORPS C2 SYSTEMS [TWP/LW, ASD (C3I)-T&TC3]
- A COMMON ARMY TACTICAL COMMAND AND CONTROL INFORMATION SYSTEM (ATCCIS) FOR THE CENTRAL REGION [ASD (C3I)-T&TC3]
- JOINT TACTICAL C3 ARCHITECTURES [JTC3A, USSOCOM]
  - Joint Special Operations Forces (Phase II)
  - Air Operations Tasks
  - Control of Operations in a Joint Task Force
- ASSESSMENT OF THE ARMY TACTICAL COMMAND AND CONTROL SYSTEM (ATCCS) [PA&E]
- INTEROPERABILITY OF U.S. AND NATO ANTI-JAM COMMUNICATIONS SYSTEMS [JCS]
- C3 COUNTERMEASURES ASSESSMENT [ASD (C3I)]
- U.S./ROK BILATERAL C3 INTEROPERABILITY [JCS]
- OPTIONS TO IMPROVE THE EUROPEAN THEATER AIR COMMAND AND CONTROL SYSTEM [ASD (C3I), JCS]
- PLANNING AID FOR JOINT CONTINGENCY CEOI [JCS]

RPW-10-20-89-5

System Concept Assessment

OBSERVATIONS ON ADP SUPPORT OF A JOINT TASK FORCE

- A JOINT FORCE-LEVEL CONTROL SYSTEM (JFLCS) IS NEEDED BY JTF COMMANDERS
- IF NOT BASED ON MCS AND FIREMAN, JFLCS SHOULD BE BASED ON STANDARDS THAT ENSURE INTEROPERABILITY WITH THESE SYSTEMS
- JFLCS WOULD SUPPORT COMPONENT COMMANDERS FOR SPECIAL OPERATIONS AND MARITIME FORCES AS WELL AS THE LCC AND ACC
- A MARINE VERSION OF FLCS COULD BE AN INITIAL JFLCS, SINCE MANY OF THE MARINE CORPS-UNIQUE REQUIREMENTS (e.g., AIR-GROUND) ARE ALSO JTF REQUIREMENTS
- NEED TO ENSURE JFLCS, MCS, MAGTF MCS, TACS, TFDS, AND FDDS INTEROPERABILITY
- OPPORTUNITIES:
  - Implementing automated support for Joint CEOI
  - Addressing lethal and non-lethal target coordination for Joint C3CM
  - Exporting TIC process to JTC3A to supplement the Interoperability Planning System (IPS)

RPW-10-20-89-8

Maneuver Control Assessment

ISSUES FOR CONSOLIDATED GENERIC REQUIREMENTS

- RELATIONSHIP TO 1989 TCO AND FIREMAN DRAFT ROCs
- RELATIONSHIP TO FMF INITIATIVES
- DEGREE OF RUGGEDIZATION
- DEGREE OF FLEXIBILITY TO SUPPORT INDIVIDUAL COMMANDER'S REQUIREMENTS FOR CP CONFIGURATION AND DATABASE SUMMARIES FOR DECISIONMAKING
- NEED FOR SUPPORT AT EVERY ECHELON
- MODIFICATIONS TO MCS (e.g., ADDING PLI) TO MEET MARINE CORPS REQUIREMENTS

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Maneuver Control Assessment

ANALYSIS OF ARMY'S MISSION TRAINING PLAN (MTP)

- ARTEP MTP[1] IDENTIFIES C2 TASKS AND PERFORMANCE STANDARDS IN THE EXECUTION OF CURRENT DOCTRINE
- MORE THAN HALF OF THE TASKS ARE DIRECTED TOWARDS GENERIC MANEUVER CONTROL FUNCTIONS: MAINTAIN, RECORD, DISSEMINATE, PROVIDE, SYNCHRONIZE, COORDINATE, PREPARE, MONITOR, AND REVIEW
- ADP SUPPORT OF THESE C2 TASKS WOULD BE ADDRESSED, AT LEAST IN PART, BY:
  - Database access and management
  - Graphical display
- THE CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL SUPPORTS 78% OF THE C2 TASKS; THE OTHERS (PLANNING, ANALYZING, AND SUPERVISING) COULD BE P3I

CONCLUSION: THE PROPOSED CONSOLIDATED GENERIC CAPABILITY FOR MANEUVER CONTROL APPEARS TO SUPPORT MOST OF THE ARMY AS WELL AS THE MARINE CORPS ADP-SUPPORTED C2 TASKS

[1] ARTEP 71-100-MTP, *Mission Training Plan,* Draft, TRADOC (ATZL-TA1-A)/CACDA, 1 July 1988.

RPW 11-22-89-20

Maneuver Control Assessment

CHANGES IN MCS ROC FROM JUL 82 TO SEP 89

- REPLACED MASS STORAGE DEVICE AT CORPS AND DIVISION TO ALLOW FOR INCREASED RANDOM ACCESS MASS STORAGE CAPABILITY

- INTRODUCED TWO NDI DEVICES (TCP, AC)
  - -- To supplement MILSPEC devices throughout force at Corps, Division, Brigade, and selected Battalions
  - -- To emulate capabilities of MILSPEC devices, but possessing reduced environmental protection

- PLACED PORTABLE COMPUTER UNIT (V2) AT THE MANEUVER BATTALION AND AT SELECTED ENGINEER, MILITARY POLICE, AND CHEMICAL COMPANIES

- INTRODUCED A LARGE-SCALE PRINTER/PLOTTER (LSPP) TO PRODUCE PAPER AND ACETATE OVERLAYS DERIVED FROM DATA STORED IN MCS DEVICES

- INTRODUCED THE TACTICAL DISPLAY PANEL (TDP) TO DISPLAY BATTLEFIELD AND DECISION GRAPHICS FROM DATA STORED IN MCS DEVICES

- OPERATIONAL CHARACTERISTICS MODIFIED TO ADDRESS:
  - -- Efforts to reduce electromagnetic signature
  - -- Increase the quality of battlefield graphics
  - -- Reduce the MILSPEC standards for the new NDI devices
  - -- Provide increased EMI shielding

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Maneuver Control Assessment

OBSERVATIONS FOR MARINE CORPS ON MANEUVER AND FORCE-LEVEL CONTROL

- CURRENT (DRAFT) FIREMAN ROC FOCUSES ON GCE
- NEED TO ADDRESS FORCE-LEVEL ADP SUPPORT OF REQUIREMENTS FOR MAGTF, GCE, ACE, AND CSSE COMMANDERS
- REQUIREMENTS AND FUNCTIONAL SPECIFICATIONS ARE NOT YET DEFINED FOR INTEGRATING ADP SUPPORT OF FIRE AND MANEUVER
- NEED TO EXPLICITLY EVALUATE DEGREE TO WHICH FMF INITIATIVES MEET FIREMAN REQUIREMENTS
- NEED TO ASSESS DEGREE TO WHICH TDSs USED IN GARRISON CAN OR WILL BE USED TACTICALLY

RPW-10-20-89-14

Air Operations Assessment

AIR PICTURE CONSIDERATIONS FOR ARMY

- BATTLEFIELD AIR PICTURE--A DISPLAY OF CORRELATED FRIENDLY, HOSTILE, AND UNKNOWN AIR TRACK INFORMATION; AIRSPACE & FS COORDINATION MEASURES; UNIT BOUNDARIES; AND UNIT LOCATIONS

- ARMY'S PRIMARY FOCUS--ON AIRSPACE BELOW COORDINATING ALTITUDE

- ADEQUATE LOW-ALTITUDE AIR PICTURE NEEDS TO BE MULTI-SOURCED; MAY INCLUDE AN AIR PLATFORM AND NEW GROUND SENSORS

- ARMY HAS TODAY NO AIR PICTURE FOR
  - -- A2C2 cell for airspace coordination
  - -- SHORAD UNITS
  - -- FOC/FCC nodes that provide air traffic services

RPW-10-20-89-16A

Air Operations Assessment

AIR PICTURE CONSIDERATIONS FOR MARINE CORPS

- MARINE CORPS IS CONCERNED WITH AIRSPACE BOTH ABOVE AND BELOW THE COORDINATING ALTITUDE
- CURRENTLY THE AIR PICTURE IS PROVIDED THROUGH ORGANIC SENSORS AND JTAO
- AIR PICTURE IS DISPLAYED AT TACC AND TAOC, BUT NOT AVAILABLE TO DASC OR FSCCs (NO TADIL ACCESS)
- MARINE CORPS ATC UNITS HAVE ATC RADARS AND MATCALS WITH TADIL B CAPABILITY TO DEVELOP AN AIR PICTURE
- MARINE CORPS HAS SURVEILLANCE RADAR FOR ATC AND HIGH-ALTITUDE AIR DEFENSE, BUT NONE FOR LAAD
- MARINE CORPS HAS NO ORGANIC AIR PLATFORM TO SUPPLEMENT SURVEILLANCE RADARS

RW-11/15/89-5

Air Operations Assessment

POTENTIAL TO EXPLOIT SERVICES' CAPABILITIES AND INITIATIVES TO MEET EXPANDING NEEDS FOR AIR PICTURE

- DISTRIBUTED AIR PICTURE PLANNED FOR FAAD C3I COULD BE PROVIDED TO A2C2 CELL, TAIS (FOC/FCC), AND DASC
- CONCEPTS FOR EVOLUTIONARY HIMAD C2 IMPROVEMENTS TO TSQ-73 AND PATRIOT ICC SHOULD INCLUDE MCE/TAOM APPROACH
- BOTH SERVICES SHOULD ASSESS THE POTENTIAL OF A SINGLE TYPE OF AIR DEFENSE C2 MODULE TO DEVELOP AN AIR PICTURE AND TO SUPPORT COUNTERAIR ENGAGEMENT OPERATIONS FOR HIMAD AND FAAD/LAAD OPERATIONS
- BOTH SERVICES SHOULD EXPLORE OPTIONS TO INTEGRATE SELECTED PORTIONS OF AN ALL-ALTITUDE AIR PICTURE WITH GROUND PICTURES BEING DEVELOPED FOR MANEUVER CONTROL AND FIRE SUPPORT TACTICAL DATA SYSTEMS
- BOTH SERVICES SHOULD EXPLORE OPTIONS TO ACCESS AIR PICTURES AVAILABLE THROUGH NAVY AND AIR FORCE (e.g., TADILs A, B, AND J)

RW-11/15/89-3

Air Operations Assessment

ADP SUPPORT FOR AIR PICTURE

AVAILABLE TODAY (USMC)

- PROCEDURAL CONTROL MEASURES
- PREPLANNED MISSION DATA
- STATUS OF CURRENT MISSION (UPON REQUEST VIA TACC OR DASC)
  - -- Number of aircraft
  - -- Duration of mission
  - -- Mission start and end
  - -- Planned loadouts

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NEEDED FOR FUTURE (ARMY, USMC)

- WIDER AREA OF INTEREST
- INCREASED RANGE OF ALTITUDES
- ADDITIONAL AIRCRAFT TYPES
- COMBINED REPRESENTATIONS OF AIR SPACE AND FIRE SUPPORT COORDINATION MEASURES
- MORE TIME INFORMATION
  - -- Position/heading of selected a/c
  - -- Planned air tracks of en route missions
  - -- Loadout data on active missions
- DETAILED PLANNING DATA

Air Operations Assessment

EXAMPLE ARMY USE OF TAOM/MCE

- TAOM/MCE COULD PROVIDE INTEGRATED, CORRELATED AIR PICTURE OF FRIENDLY, HOSTILE, AND UNKNOWN TRACKS TO:
  - HIMAD PATRIOT ICC and HAWK Operations Center (TSQ-73)
  - Follow-on to ICC and TSQ-73 Upgrade
  - Common operations center facility for the mixing or task organizing of HAWK/PATRIOT ADA brigades
  - Common interface facility link using TADIL A/B with USAF, Marine, and Navy Joint Force Components, as well as AWACS and E2C
  - Army FCC and FOC nodes supporting air traffic services
  - A2C2 corps and division operations cells
  - FAAD C2I air defense nodes (e.g., ABMOC)

RPW-10-20-89-18

Interoperability Assessment

FACTORS LEADING TO CURRENT AND FUTURE INTEROPERABILITY PROBLEMS

- DIGITAL ENTRY DEVICES REPLACING VOICE-MANUAL MODE (COULD LIMIT FLEXIBILITY AND INCREASE NUMBERS OF MESSAGES)
- LITTLE INTER-SERVICE TDS INTEROPERABILITY ACHIEVED EXCEPT FOR JTAO IN AIR DEFENSE
- NO JOINT FORCE-LEVEL CONTROL SYSTEM (e.g., FOR JOINT TASK FORCE)
- NEED AUTOMATED SUPPORT FOR DATA TRANSFER
  - Imagery
  - Database (partial) replication, update, access, and retrieval
  - Communications support for increased digital data loads
- PRECEDENCE OF INTEROPERABILITY REQUIREMENTS, NATO VERSUS U.S. JOINT

RPW-10-20-89-13

Interoperability Assessment

OBSERVATIONS FOR ARMY ON DATA COMMUNICATIONS STANDARDIZATION

- ARMY HAS PROVIDED U.S. REPRESENTATIVE IN DATA COMMUNICATIONS AND LAND WARFARE PROCEDURAL STANDARDS BODIES
  - -- NATO STANAGs (5620 ON FIRE SUPPORT, 5621 ON MANEUVER)
  - -- TSGCEE SG9 (WG1 CHAIR)
  - -- U.S. (PSSG, FSSG, JTC3A)

- ATCCS CHS INCLUDES OSI STANDARDS FOR LAN (ISO 8802.3) AND PACKET-SWITCHING (CCITT X.25)

- ARMY HAS DRAFT TRANSITION PLAN TO ADDRESS ADDITIONAL TACTICAL USE OF OSI PROTOCOLS

- ATCCS DEVELOPING ALLIED INTERFACES
  - -- QUADRILATERAL INTEROPERABILITY PROGRAM (HEROS, SACRA, WAVELL)
  - -- FIRE SUPPORT (ADLER, BATES)
  - -- NONE ARE FULLY OSI COMPATIBLE (QIP WAS DERIVED FROM CCITT X.400 1984)

RPW (1-2-90-1)

Interoperability Assessment

OBSERVATIONS FOR MARINE CORPS ON DATA COMMUNICATION STANDARDIZATION

- **USMC HAS BECOME MORE ACTIVE IN BODIES WORKING ON DATA COMMUNICATION STANDARDS**
  - NATO (TSGCEE SG9 WG1)
  - DCA (PSSG, PSTP)
  - JTC3A (FSSG)
- **MTS BROADCAST STANDARD COULD BE A BASIS FOR JOINT INTEROPERABILITY**
  - For digital entry devices (e.g., DCT) and between TDSs
  - Possible modification of MTS required to support the new JINTACCS K-Series (bit-oriented) messages
- **TRANSITION TO CIVIL OPEN SYSTEMS STANDARDS REQUIRES PLANNING, STUDY, EXPERIMENTATION, AND TESTING**
- **JOINT AND COMBINED INTEROPERABILITY BOTH NEED TO BE CONSIDERED IN PLANNING FOR ADVANCED TDSs, ESPECIALLY FOR MANEUVER AND FORCE-LEVEL CONTROL**

RPW-10-20-89-12

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Appendix F

GLOSSARY

Appendix F

GLOSSARY

A2C2	Army Airspace Command and Control
ABIC	Army Battlefield Interface Concept
ABMOC	Air Battle Management Operations Center (U.S. Army)
AC2MP	Army Command and Control Master Plan
ACC	Air Component Commander
ACE	Aviation Combat Element (USMC)
ADA	Air Defense Artillery
ADatP	Allied Data Publication (NATO)
ADCCS	Air Defense Command and Control Systems
ADP	Automated Data Processing
AFATDS	Advanced Field Artillery Tactical Data System
ALADNS	Automatic Location and Data Netting Systems (PLRS modification)
APIU	Adaptive Programmable Interface Unit
ARTEP	Army Training and Evaluation Plan
ASARC	Army Systems Acquisition Review Council
ASAS	All-Source Analysis System
ASD	Assistant Secretary of Defense
ATACC	Advanced Tactical Air Command Center
ATACMS	Army Tactical Missile System
ATC	Air Traffic Control
ATCCIS	Army Tactical Command and Control Information System (NATO)
ATCCS	Army Tactical Command and Control System (U.S. Army)
ATHS	Airborne Target Handoff System
AWACS	Airborne Warning and Control System (USAF)
AWIS	Army WWMCCS Information System
BCS	Battery Computer System
BFA	Battlefield Functional Area

BITE	Built-In Test Equipment
BOM	Bit-Oriented Message
C2	Command and Control
C2IE	Command and Control Information Exchange (element)
C2MP	Command and Control Master Plan
C3	Command, Control, and Communications
C3CM	C3 Countermeasures
C3I	Command, Control, Communications, and Intelligence
C4	Command, Control, Communications, and Computers
CAC	Combined Arms Center (U.S. Army)
CACDA	Combined Arms Center Development Activity (U.S. Army)
CAEMS	Computer-Aided Embarkation System
CAS	Close Air Support
CASS	Common Applications Support Software (ATCCS)
CCIR	Commander's Critical Information Requirements
CCIS	Command and Control Information System
CCITT	International Telephone and Telegraph Consultative Committee
CCS	Command and Control Systems
CECOM	U.S. Army Communications-Electronics Command (Fort Monmouth)
CEI	Critical Elements of Information
CEOI	Communications-Electronics Operating Instructions
CHS	Common Hardware and Software
CMD	Color Monitor Device (ATCCS CHS)
CNAD	Council of Naval Armaments Directors (NATO)
COC	Combat Operations Center
COEA	Cost and Operational Effectiveness Assessment
COMSEC	Communications Security
CONOPS	Continuity of Operations
CP	Command Post
CRC	Control and Reporting Center (USAF)
CSS	Combat Service Support
CSSCS	Combat Service Support Control System (ATCCS)
CSSE	Combat Service Support Element (USMC)
CSSIN	CSS Information Network

DAB	Defense Acquisitions Board
DASC	Direct Air Support Center (USMC)
DCA	Defense Communications Agency
DCT	Digital Communications Terminal
DDN	Defense Data Network
DEUCE	Down-Sized End-User Computer Equipment
DIR	Director
EDM	Engineering Development Model (MIFASS)
EPLRS	Enhanced Position Location Reporting System
ETACCS	European Theater Air Command and Control System
EUCE	End-User Computer Equipment
EW	Electronic Warfare
FAAD	Forward Area Air Defense (low-altitude)
FAC	Forward Air Controller
FAMMIS	Finance and Manpower Management Information System
FAR	Forward Area Radar
FATDS	Field Artillery Tactical Data Systems
FCC	Flight Coordination Center (U.S. Army)
FDC	Fire Direction Center
FDDS	Flag Data Display System (USN)
FDL	FAAD Data Link
FED	Forward Entry Device
FIA	Functional Interoperability Architecture
FIREFLEX	Flexible Fire Support System (USMC)
FIREMAN	Fire and Maneuver System (USMC)
FIST DMD	Fire Support Team Digital Message Device (U.S. Army)
FLCC	Force-Level Control Capability
FLCS	Force-Level Control System
FLOT	Forward Line of Troops
FM	FIREMAN
FMF	Fleet Marine Force
FMFM	Fleet Marine Force Manual
FO	Forward Observer
FOC	Flight Operations Center (U.S. Army)

FS	Fire Support
FSCC	Fire Support Coordination Center (USMC)
FSE	Fire Support Element (U.S. Army)
FSSG	Fire Support Subgroup (JTC3A)
FY	Fiscal Year
GCE	Ground Combat Element (USMC)
GKS	Graphics Kernel System
GOSIP	Government Open Systems Interconnection Profile
GPS	Global Positioning System
HDU	Hard Disk Unit (ATCCS CHS)
HF	High Frequency
HIMAD	High- and Medium-Altitude Air Defense
HIP	Howitzer Improvement Program
HMMWV	High Mobility Multi-Wheeled Vehicle
HQDA	Headquarters, Department of the Army
HQMC	Headquarters, USMC
HTU	Handheld Terminal Unit
IAS	Intelligence Analysis System
ICC	Information Coordination Central (PATRIOT)
IDASC	Improved Direct Air Support Center
IEEE	Institute of Electrical and Electronics Engineers
IER	Information Exchange Requirement
IEW	Intelligence and Electronic Warfare
IFASC	Improved Force Automated Services Center
IHFR	Improved High Frequency Radio
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IPS	Interoperability Planning System (JTC3A)
ISO	International Standards Organization
ITAWDS	Integrated Tactical Amphibious Warfare Data System
ITC	Inter-Task Communications

JCS	Joint Chiefs of Staff
JFLCS	Joint Force-Level Control System
JINTACCS	Joint Interoperability Tactical Command and Control System
JMSWG	Joint Multi-TADIL Standards Working Group (JTC3A)
JSIPS	Joint Service Imagery Processing System
JTC3A	Joint Tactical C3 Agency
JTF	Joint Task Force
JTIDS	Joint Tactical Information Distribution System
LAAD	Low-Altitude Air Defense
LAN	Local Area Network
LCAC	Landing Craft, Air-Cushioned
LCC	Land Component Commander
LHA	Amphibious Assault Ship
LHD	Amphibious Assault Ship
LLEWDS	Low-Level Early Warning Defense System
LSPP	Large-Scale Printer/Plotter
LTACFIRE	Lightweight TACFIRE (Briefcase Terminal)
LW	Land Warfare
M3S	Marine Corps Standard Supply System
MACCS	Marine Air Command and Control System
MAFATDS	Marine Version of AFATDS
MAGIS	Marine Air-Ground Intelligence System
MAGTF	Marine Air-Ground Task Force
MARDIV	Marine Division
MASC	MAGTF Automated Services Center
MATCALS	Marine Air Traffic Control and Landing System
MCC2MP	Marine Corps Command and Control Master Plan
MCCDC	Marine Corps Combat Development Command
MCE	Modular Control Equipment (USAF)
MCRDAC	Marine Corps Research, Development and Acquisition Command
MCS	Maneuver Control System
MCTCA	Marine Corps Tactical Communications Architecture
MCTSSA	Marine Corps Tactical Systems Support Activity
MDS	Meteorological Data System

MEB	Marine Expeditionary Battalion
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MIFASS	Marine Integrated Fire and Air Support System
MILOGS	Marine Integrated Logistics System
MILSPEC	Military Specification
MIPS	Marine Integrated Personnel System
MLRS	Multiple Launch Rocket System
MOA	Memorandum of Agreement
MS	Master Station (PLRS)
MSE	Mobile Subscriber Equipment (U.S. Army)
MTACCS	Marine Tactical Command and Control System
MTF	Message Text Format (JINTACCS)
MTP	Mission Training Plan (U.S. Army)
MTS	Marine Tactical System (USMC)
NBC	Nuclear, Biological, and Chemical
NDI	Non-developmental Item
NGF	Naval Gunfire
NIMP	NATO Interoperability Management Plan
NIPD	NATO Interoperability Planning Document
NTDS	Naval Tactical Data System
O&O	Organizational and Operational (Plan)
OASD	Office of the Assistant Secretary of Defense
OH	Operational Handbook (USMC)
OPM	Office of the Program Manager
OPTADS	Operational Tactical Data Systems
OSD	Office of the Secretary of Defense
OSI	Open Systems Interconnection
OTEA	Operational Test and Evaluation Agency
P3I	Preplanned Product Improvements
PA&E	Program Analysis and Evaluation (OSD)
PC	Personal Computer
PCU	Portable Computer Unit (ATCCS CHS)

PEO	Program Executive Officer
PJHI	PLRS-JTIDS Hybrid Interface
PLI	Position Location Information
PLRS	Position Locating Reporting System
PNL	Battelle Pacific Northwest Laboratories
POSIX	Portable Operating System Interface for Computer Environments
PSSG	Protocol Standard[illegible]ering Group
PSTP	Protocol Standard[illegible]echnical Panel
R&D	Research and Development
RFP	Request for Proposals
ROC	Required Operational Capability (statement)
RPV	Remotely Piloted Vehicle
SACC	Supporting Arms Command Center
SAM	Surface-to-Air Missile
SBB	Switched Backbone (USMC communications)
SC	Subcommittee
SCR	Single-Channel Radio
SDU	Standalone Display Unit (ATCCS CHS)
SEMA	Special Electronic Mission Aircraft
SINCGARS	Single-Channel Ground-Air Radio System
SM	System Management
SMI	Soldier-Machine Interface
SMRAALS	Shipboard Remote Area Approach and Landing System
SOR	Statement of Requirements
SQL	International Standard Query Language
SRI	Standing Request for Information
STAMIS	Standard Tactical Army Management Information System
STANAG	NATO Standardization Agreement
T&TC3	Theater and Tactical C3
TACFIRE	Tactical Fire Direction System (U.S. Army)
TACS	Tactical Air Control Sys[illegible] (USAF)
TADIL	Tactical Data Link
TAIS	Tactical Air Integration System

TAOC	Tactical Air Operations Center
TAOM	Tactical Air Operations Module (USMC)
TBD	To Be Determined
TCAC	Technical Control and Analysis Center
TCO	Tactical Combat Operations (system) (USMC)
TCP	Tactical Computer Processor
TCT	Tactical Computer Terminal
TCU	Transportable Computer Unit (ATCCS CHS)
TDS	Tactical Data System
TERPES	Tactical Electronic Reconnaissance Processing and Evaluation System
TFCC	Tactical Flag Command Center
TFDS	Tactical Flag Data System
TIC	Technical Interface Concept
TIDP	Technical Interface Design Plan
TRADOC	U.S. Army Training and Doctrine Command
TRI-TAC	Joint Tactical Communications Program
TSGCEE	NATO Tri-Service Group on Comm-Electronics Equipment
TWP	Tactical Warfare Programs (OSD)
UIR	User Information Requirement
ULCS	Unit-Level Circuit Switch
ULTDS	Unit-Level Tactical Data Switch (USMC)
USAREUR	U.S. Army in Europe
UTACCS	USAREUR Tactical Command and Control System
VMF	Variable Message Format (JINTACCS K-Series)
VTOL	Vertical Take-Off and Landing
WG	Working Group
WIS	WWMCCS Information System
WWMCCS	World-Wide Military Command and Control System

APPENDIX G

BACKGROUND, OBJECTIVE, AND STATEMENT OF WORK

APPENDIX G

BACKGROUND, OBJECTIVE, AND STATEMENT OF WORK

This Briefing Book was written in response to Task Order T-F1-654. Those portions of the task order that pertain to the background and objectives of the task, and the statement of work provided therein by the sponsoring office, are reprinted here.

2. BACKGROUND:

The Army and Marine Corps are developing and fielding significant improvements in automated support for command and control in air operations, fire support, and maneuver control. Both Services currently employ a Battery Computer System, a Meteorological Data System, a Digital Communications Terminal, the fire support system nicknamed FIREFINDER, and the improved surface-to-air system HAWK. Each Service has developed additional systems that appear to have significant potential to support automated command and control for the other Services. The Army has three fire support systems that potentially could meet Marine Corps requirements: Fire Support Team Digital Message Device, Lightweight TACFIRE, and the Advanced Field Artillery Tactical Data System (AFATDS). In addition, the Army's Maneuver Control System (MCS) and the AFATDS appear to have potential for an objective integrated fire and maneuver system for the Marine Corps. On the other hand, the Marine Corps/Air Force Tactical Air Operations Module (TAOM)/Modular Computer Element could potentially meet some Army command and control (C2) requirements for Forward Area Air Defense (FAAD). Further, the Marine Corps Advance Tactical Air Command Center (ATACC) might have application to Army aviation C2 needs. A detailed assessment of a range of potential options for subsystem commonality is required to insure prudent and informed decisionmaking on development and acquisition strategies.

3. OBJECTIVE:

The objective of this study is to review Army and Marine Corps Requirements in air operations, fire support, and maneuver control in order to identify options for incorporating existing and emergi g systems of one Service for use by the other Service. Moreover, it is understood that an included objective of the task is the identification and assessment of interoperability issues.

4. STATEMENT OF WORK:

a. IDA will identify and monitor planned Army and Marine Corps evaluations of fire support systems. As a related matter, IDA will continue to assist the Marine Corps in their plans for an operational assessment of AFATDS at the end of FY 1989.

b. IDA will review Army airspace command and control requirements and address the potential of the Marine Corps' TAOM, ATACC and Improved Direct Air Support Center (IDASC) to satisfy in whole or part the Army's requirement for a Tactical Airspace Integration System (TAIS).

c. IDA will review both Army and Marine Corps requirements associated with the maneuver control function and address the potential of MCS and AFATDS to be integrated as a maneuver control system for the Marine Corps.

Appendix H

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